AD-A144 628 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS LOWER BOLTON LAKE DAM..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV SEP 78 1/2

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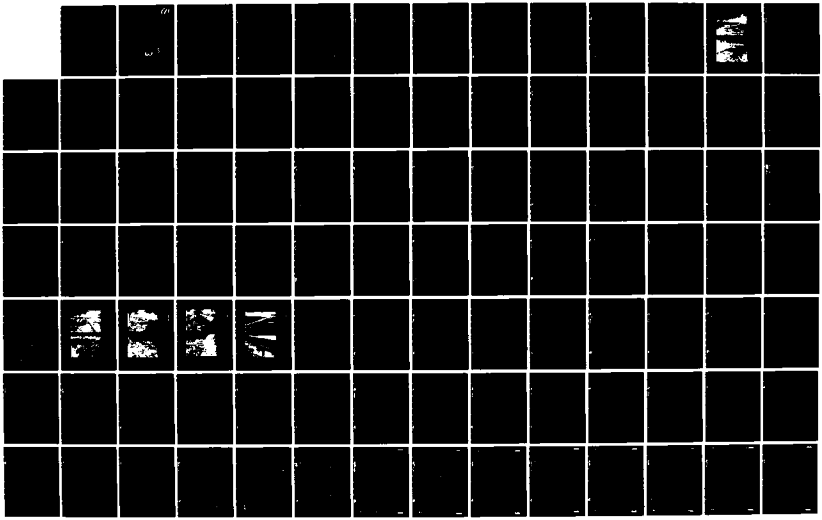

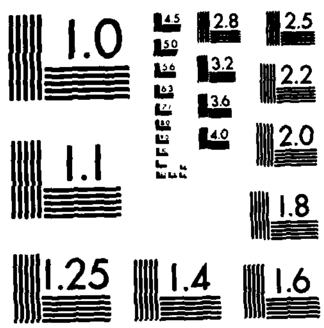

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AD-A144 628

THAMES RIVER BASIN
BOLTON, CONNECTICUT

LOWER BOLTON LAKE DAM
CT 00509

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Tolland, Connecticut
Thames River Basin
Bolton, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Lower Bolton Lake Dam is an earth embankment 880 ft. long with a maximum height of 18.5 ft. and a concrete spillway 200 ft. long at the left abutment. Maximum storage capacity is about 2,325 acre-ft. The dam is in fair condition, based on visual inspection. Lower Bolton Lake Dam falls into the intermediate size classification on the basis of storage capacity. The dam has been classified in the significant hazard potential category.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

JAN 30 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

I am forwarding to you a copy of the Lower Bolton Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, the State of Connecticut, Department of Environmental Protection, Hartford, Connecticut 06115, ATTN: Mr. Stanley J. Pac, Commissioner.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

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As stated

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LOWER BOLTON LAKE DAM

CT 00509

THAMES RIVER BASIN
BOLTON, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	CT 00509
Name of Dam:	Lower Bolton Lake Dam
Town:	Bolton
County and State:	Tolland, Connecticut
Stream:	Bolton Pond Brook
Date of Inspection:	25 September 1978

BRIEF ASSESSMENT

Lower Bolton Lake Dam is an earth embankment 880 ft. long with a maximum height of 18.5 ft., and a concrete spillway 200 ft. long at the left abutment. The outlet is a 15 in. dia. cast iron pipe at stream level with a valve on the upstream end. Maximum storage capacity is about 2,325 acre-ft. Upper Bolton Lake Dam about 2/3 mi. upstream is generally similar. Both lakes, which have a normal difference in elevation of 7 ft., are used for recreational purposes. The total drainage area is about 3.9 sq. mi., of which about 3.1 sq. mi. drains into Upper Bolton Lake. The dam discharges into Bolton Pond Brook, a tributary of the Hop River.

Lower Bolton Lake Dam falls into the intermediate size classification on the basis of storage capacity. Because failure might damage a small number of homes and local roads, the dam has been classified in the significant hazard potential category.

The nineteenth century dam was breached in two places during a hurricane in 1938. Reconstructed in 1940-41 by the W.P.A., the dam failed again in 1941. During the next three years, a series of repair and reconstruction operations were undertaken by various contractors. No plans were recovered for any of this work.

The dam is in fair condition, based on visual inspection. The spillway is adequate to pass the test flood without overtopping the dam. Cracks in the spillway concrete slabs were noted. The downstream slope and discharge channel are considerably overgrown. The 15 in. dia. outlet pipe is too small to have any significant effect during a flood event.

The owner should retain the services of a competent registered professional engineer and implement the results of his evaluation of:
1) the need to close off possible saddles at both abutments, and
2) the feasibility of providing a larger capacity outlet for lowering the reservoir.

The owner should implement the following maintenance measures: remove brush and trees from dam embankment; reinstate riprap on upstream slope; monitor wet areas at toe of downstream slope; monitor cracks in spillway structure; develop a formal flood warning system and emergency operational procedure.

Peter B. Dyson
Project Manager

COMMONWEALTH OF MASSACHUSETTS
PETER BRIAN DYSON
No. 18452
REGISTERED PROFESSIONAL ENGINEER

Frederick Esper
Vice President

COMMONWEALTH OF MASSACHUSETTS
FREDERICK ESPER
No. 8309
REGISTERED PROFESSIONAL ENGINEER

This Phase I Inspection Report on Lower Bolton Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard F. Doherty

RICHARD F. DOHERTY, MEMBER
Water Control Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph A. McElroy

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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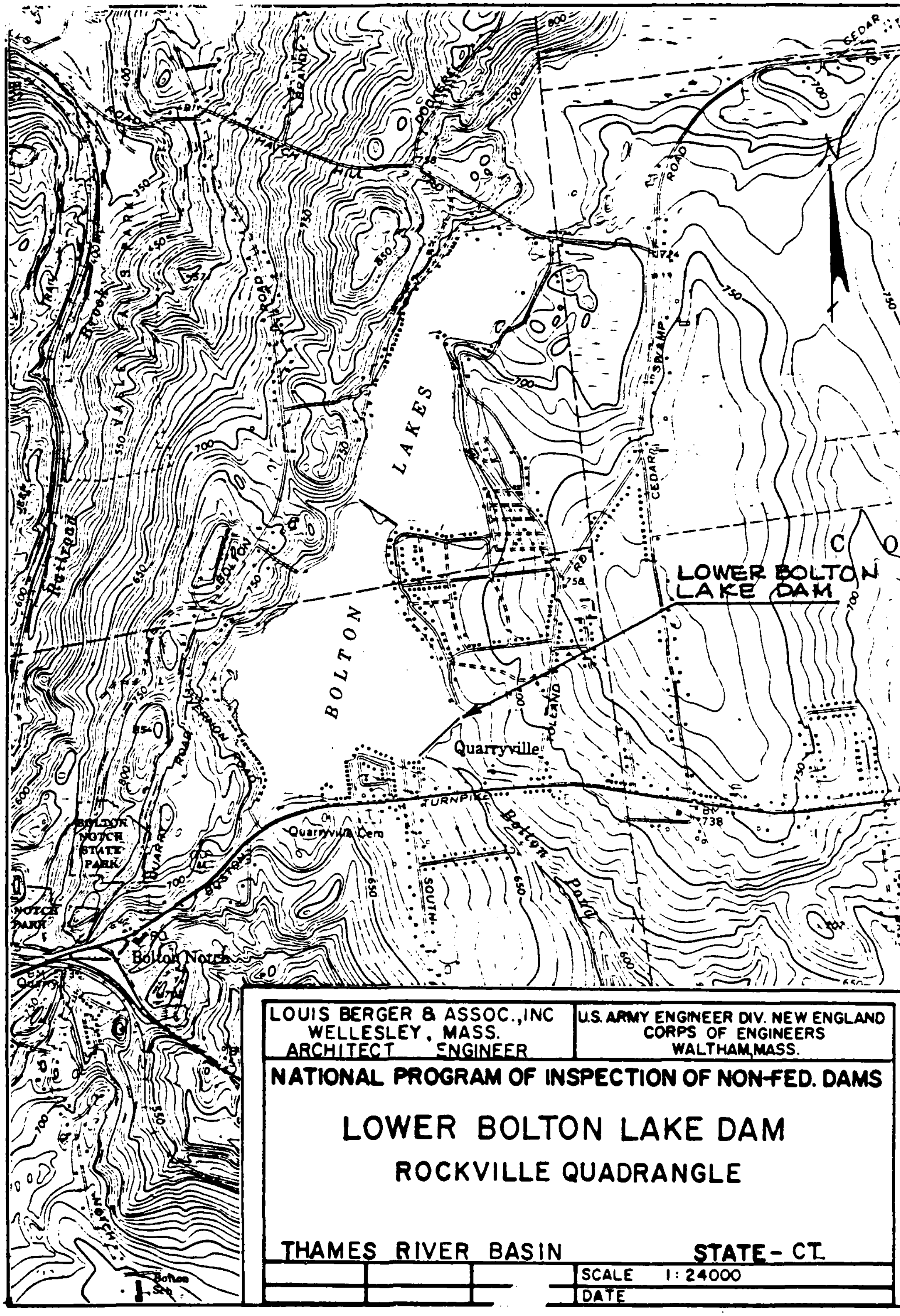
LOWER BOLTON LAKE DAM OVERVIEWS

Overview from Right Abutment (Boat Launching Ramp)

Overview from Left Abutment



LOWER BOLTON LAKE DAM
BOLTON LAKES
Quarryville
Quarryville Cem
Bolton Notch
BOLTON NOTCH STATE PARK
NOTCH PARK
TURNPIKE
CEDAR
SWAMP
ROAD
Railroad
LOUIS BERGER & ASSOC.,INC
WELLESLEY, MASS.
ARCHITECT ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM,MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
LOWER BOLTON LAKE DAM
ROCKVILLE QUADRANGLE
THAMES RIVER BASIN
STATE - CT.
SCALE 1:24000
DATE

PHASE I INSPECTION REPORT

LOWER BOLTON LAKE DAM CT 00509

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 24 August 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0371 has been assigned by the Corps of Engineers for this work.

b. Purpose

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Lower Bolton Lake Dam is located on Bolton Pond Brook in the Town of Bolton, Tolland County, Connecticut. Bolton Pond Brook is a tributary of the Hop River and the project is 2.5 miles upstream from the confluence with that river. The Hop River joins the Shetucket River, a tributary of the Thames

River. The Dam is 1,000 ft. upstream of the Boston Turnpike, Alternate US Route 44. Upper Bolton Lake Dam is about 2/3 mile upstream and at normal storage the upper lake is 7 ft. above the lower lake.

b. Description of Dam and Appurtenances

The dam consists of an earth embankment 880 ft. long and a concrete spillway 200 ft. long. It has a maximum height of 18.5 ft. and riprap protection on the upstream slope. The spillway is a concrete overflow sill with a short apron placed in an unlined earthen channel at the left end of the dam. The outlet is a 15 in. dia. cast iron pipe carried through the dam at stream level, with an upstream valve control. The upper dam is of similar construction but the spillway is about 150 ft. long. Appendix D, Plates 3 and 4, show sketches of both dams.

c. Size Classification

While the maximum height of the dam is only 18.5 ft., the storage capacity of the lake at maximum pool elevation is 2,325 acre ft. Therefore, the dam is in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The southern and eastern shorelines of the lake are occupied by private residences. In addition, there are homes abutting the downstream toe of the dam as well as several residences along the downstream flood plain. About a thousand feet downstream, the channel is bridged by the Boston Turnpike (Alternate Route 44). A breach in the vicinity of the right abutment could cause damage to the three homes near the downstream toe, with possible loss of life. Three residences and a service station in the vicinity of the Alternate Route 44 bridge could be inundated by a few feet, but loss of life would be less probable. A few homes along the Hop River farther downstream could also be affected by a flood event. The dam therefore represents a significant hazard potential and is classified accordingly.

e. Ownership

The dam is owned by the State of Connecticut, Department of Environmental Protection, Water and Related Resources Section. It was originally built by Bolton Reservoir and Water Power Company of Andover, CT about 1856. Ownership was subsequently transferred to the Connecticut Light and Power Company.

In 1939 Bolton Lake and the remains of the upper and lower dams (both breached during a hurricane in September 1938) were donated to the State of Connecticut by the Connecticut Light and Power Company, and taken over by the State Board of Fisheries and Game.

f. Operator

Mr. John Spencer, Regional Manager
Department of Environmental Protection, Region 3
209 Hebron Road
Marlborough, CT 06447

telephone: (203) 295-9523

g. Purpose of Dam

The dam impounds a lake used for recreational purposes.

h. Design and Construction History

The original dam was built by Bolton Reservoir and Water Power Company of Andover, CT, about 1856. No information was recovered regarding the original design and construction.

During a hurricane in September 1938 the dam was overtopped and breached in two places. Upper Bolton Lake Dam, about 3,500 ft. upstream of this dam, was also breached. In 1940 the Connecticut State Assembly appropriated funds to cover part of the cost of rebuilding the two dams. The State Public Works Department then prepared designs which were approved by the War Department (see Appendix B).

Both the Upper and Lower dams were rebuilt in 1940-41 as a Federal W.P.A. project using relief labor. As a Federal project, State agencies lacked authority to control the work. From the record of observations by State officials and the War Department, it appears that the approved design was not followed completely, that the quality of workmanship was poor, and that the work was never fully completed owing to lack of funds.

The Lower Dam failed again on June 9, 1941, washing out a section of the Boston Turnpike (then US Route 44, now Alternate 44) 1,000 ft. downstream and damaging the highway bridge over Bolton Pond Brook. The new break was in the same general location as the easterly of the two 1938 breaks. A week later a contract was let to Alexander Jarvis Company of Manchester, CT, to make repairs under the direction of the State Public Works Department. No detailed information was recovered regarding the precise extent of this work, but the break was repaired with a steel sheet core and backfill on both sides from the bottom of the pond. The steel sheeting was driven to refusal and cut off to a level line substantially 7 ft. below the spillway elevation. The earth fill was

dumped from trucks and spread by bulldozer, but was not otherwise compacted. Steel sheeting was also driven through the embankment in the vicinity of the westerly 1938 break and cut off 2 to 3 ft. below the top of the embankment.

During the winter of 1941-42 seepage under the spillway reached an estimated 3,500 gallons per minute and in April 1942 the State Public Works Department awarded a contract to the A. I. Savin Construction Company to drive steel sheet piling along the upstream side of the spillway. No detailed information has been recovered but the tops of the sheet piles can be seen along the entire length of the spillway.

In April 1942 a large saturated area was observed about 35 ft. long on the downstream face of the dam in the vicinity of the 15 in. dia. outlet pipe. A study was made by The Haller Engineering Associates of Cambridge, MA, and in September 1942 they recommended the installation of timber sheeting near the toe of the dam for about 60 ft. and a grouting process to consolidate the affected fill. From available records it appears that this recommendation was not followed. In the spring of 1943 a contract was let to the E. B. McGurk Construction Company for repairs, details unknown, but it was found that the cost had been seriously underestimated and the contract was abrogated before work began.

In April 1943 the civil engineering firm of Chandler & Palmer of Norwich, CT, recommended that: (1) in the original easterly break area the cutoff wall be extended upwards in concrete to 2 ft. above spillway level, (2) the embankment be raised about 3 ft. to essentially the original 1938 design elevation, and (3) that stone paving be extended on the upstream face to the top of the embankment. This work was commenced in July 1943 by the Charter Oak Construction Company and completed in the spring of 1944.

Records show that in the summer of 1964 some repair work was carried out. This included repairing portions of the concrete spillway where settlement cracks had developed, raising and relaying ten concrete slabs which had been displaced on the upstream slope, and dragging up and replacing stone riprap which had sloughed into the water.

i. Normal Operational Procedure

There are no formal operational procedures. The lake level is usually lowered up to three feet each fall by opening the 15 in. dia. outlet valve, to allow lakeside residents to maintain their boat docks.

1.3 Pertinent Data

a. Drainage Areas

The total drainage area of Lower Bolton Lake Dam is approximately 3.9 square miles. About 19% (0.8 square miles) drains directly to Lower Bolton Lake Dam while the remaining 81% (3.1 square miles) drains the area of Upper Bolton Lake Dam. With the exception of a small residential community on the easterly portion of Lower Bolton Lake, the entire drainarea is largely undeveloped, consisting of relatively steep wooded slopes along the western perimeter and flatter swampy and wooded areas in the northern and eastern portion of the basin respectively. Upper Bolton Lake and a contiguous swamp to the north function as a detention basin for the majority of storm runoff within the Lower Bolton Lake drainage area.

b. Discharge at Damsite

1. Discharge from Lower Bolton Lake is provided by a single, 15 inch diameter C.I. drain. Invert elevation of this drain is 658 at the inlet and 657 at the point of discharge below the downstream toe of the dam (MSL).

2. There have been three major floods observed at this damsite within the last 40 years. There are no records of discharge for the floods of 1938 and 1941, both of which caused failure of the dam. The storm of 1944, reputedly larger than either the 1938 or 1941 storm, occurred after the spillway capacity had been enlarged substantially. The 1944 storm produced approximately five inches of precipitation in six hours as recorded by the Rockville Water & Aqueduct Company at nearby Shenipsit Lake. Residents in the vicinity of Bolton Lake claim that 8.5 to 10.5 inches of rain fell in the lake region during the June 1944 storm.

   Discharge at the Lower Bolton Lake Dam was calculated by the U.S.G.S., Hartford, Connecticut, based on the precipitation data recorded at Shenipsit Lake. Their findings indicate the flood discharge peaked at 225 cfs approximately 16 hours after the center of the storm had passed. (See flood hydrograph, Appendix B.)

3. The spillway at Bolton Lake is an ungated structure. The total spillway capacity at maximum pool elevation 672.5 MSL (top of dam) is 8,400 cfs.

c. Elevation (ft. above MSL)

1. Top of dam - 672.5
2. Maximum pool-design surcharge* - 669.8
3. Full flood control pool - 669.8
4. Recreation pool - 667
5. Spillway crest - 667
6. Upstream portal invert diversion tunnel - N/A
7. Stream bed at centerline of dam - 655
8. Maximum tailwater* - 665.6

d. Reservoir

1. Length of maximum pool - 4,800± ft.
2. Length of recreational pool - 4,700± ft.
3. Length of flood control pool - 4,750± ft.

e. Storage (acre-feet)

1. Recreation pool - 1,250 ac. ft.
2. Flood control pool - 525 ac. ft.
3. Design surcharge - 525 ac. ft.
4. Top of dam - 2,325 ac. ft.

f. Reservoir Surfaces (acres)

1. Top of dam - 210 acres
2. Maximum pool - 210 acres
3. Flood control pool - 198 acres
4. Recreation pool - 176 acres
5. Spillway crest - 176 acres

g. Dam

1. Type - earthen
2. Length - 1,080 ft.
3. Height - 18.5 ft.
4. Top width - 20 ft.
5. Side slopes - 1 on 2 downstream, 1 on 3 upstream
6. Zoning - new dam constructed over core consisting of former dam
7. Impervious core - unknown
8. Cutoff - interlocking steel sheeting driven to refusal along centerline of dam in location of two 1938/41 breaches
9. Grout curtain - unknown

* See Sheet 1, State of Connecticut, Department of Public Works, "Spillway Lower Dam Bolton Lake", Appendix B.

h. Spillway

1. Type - concrete ogee
2. Length of weir - 200 ft.
3. Crest elevation - 667
4. Gates - none
5. U/S channel - none; inflow enters directly from spillway of Upper Bolton Lake Dam
6. D/S channel - confined on both sides by wooded slopes to its confluence with the Hop River approximately 10,000 ft. downstream. Average slope of the downstream channel is 3%. Average slope of the confining walls of the channel ranges from 5% in the area between the dam and the Boston Turnpike and 10% to 20% below that road intersection.

i. Regulating Outlets

The only regulated outlet from the lake is the 15-inch diameter C.I. drain previously described. This drain is regulated by a 15-inch gate valve located on the lake side of the upstream toe of the dam. (See sheet 1, Appendix B.)

SECTION 2 - ENGINEERING DATA

2.1 Design

No data was recovered regarding the design of the original dam constructed about 1856. A plan and profile of the eastern part of the dam dated October 1939, showing the two breaks which occurred during a September 1938 hurricane, indicates an assumed embankment elevation of about 100 and a stoplog spillway with a length of about 15 ft. (See Appendix B.)

Sheet No. 1 of the State Department of Public Works drawings for reconstruction of the dam dated December 29, 1939 (see Appendix B) shows the embankment being raised to elevation 103.0 with a top width of 10 ft. and a concrete spillway with a 200 ft. crest and an elevation of 97.0. If the spillway was in fact constructed at the design elevation, 97 on the drawings corresponds approximately to 667 MSL shown as the pool elevation on Rockville Quadrangle. This design was approved by the War Department.

After reconstruction commenced in March 1940, the Federal W.P.A. submitted revised plans to the War Department with a request for approval of a change in the design of the dam. The War Department denied the approval on the grounds that the plans as approved represented a relaxation of the standards of the Department and further relaxation was not possible. The W.P.A. plans have not been recovered.

No design data has been recovered for the reconstruction work carried out after the second failure of the dam in 1941, the steel sheeting installed in the spillway in 1942, and the raising of the dam to its present level in 1943-44. Correspondence in the files of the CT Department of Environmental Protection indicates that the April 1943 recommendations of the consulting firm of Chandler & Palmer, Norwich, CT, were probably followed:

1. Construct 16 in. concrete cut-off wall on top of steel sheeting in original east break to 2 ft. above spillway elevation and extend wall into original earth embankment at both ends, the bottom of the wall to be at least 6 in. below the top of sheeting.

2. Raise the embankment to elevation 102.5 at upstream side and 103.0 at downstream side,

based on spillway elevation of 97.0, with a top width of 12 ft. and slopes of 1 vertical on 2 horizontal.

3. Continue stone paving on water side of embankment.

2.2 Construction

No data was recovered regarding construction of the original dam about 1856.

After failure in two places in 1938, the dam was reconstructed in 1940-41 as a Federal W.P.A. project. It was intended that the work be carried out in accordance with the design of the State Public Works Department which was approved by the War Department, but correspondence in the files of the CT Department of Environmental Protection indicates that the approved design was not strictly followed. The War Department inspections are said to have indicated: (1) omission of drains and riprap, (2) the embankment was not constructed to grade and deficient in cross-sectional area, (3) a spillway slab pulled loose, etc. Unable to obtain correction of these deficiencies at the local level, the Chief of Engineers, U.S. Army, was informed in May 1941 that the dam was unsafe, with a recommendation that the matter be referred to the W.P.A. in Washington. The dam failed on June 9, 1941, at the site of the easterly 1938 break.

In June 1941 repairs were undertaken by the Alexander Jarvis Company under the direction of the Public Works Department. This work included installation of a steel sheet pile core wall in the break and backfill with material from the bottom of the pond. The core wall is reported to have been cut off about 7 ft. below spillway level. Steel sheeting was also installed through the embankment in the vicinity of the westerly 1938 break and said to be cut off 2 to 3 ft. below the top of the embankment, which was apparently still at the original elevation of 100± at that time.

On July 2, 1941, the reconstruction was formally discontinued as a W.P.A. project.

In 1942 a line of steel sheet piling was installed along the upstream side of the spillway by the A. I. Savin Construction Company to alleviate seepage under the spillway.

In July 1943 a concrete cut-off wall was installed on top of the sheet piling installed across the site of the easterly 1938 and 1941 breaks and the embankment was raised to a maximum elevation of 103.0, corresponding with the 1939 design elevation. The riprap on the upstream face was extended to the top of the dam using precast concrete slabs.

2.3 Operation

There appear to be no set operating procedures for the dam. In the fall the 15 in. dia. outlet is usually opened for a period to lower the pool up to three feet so that lakeside residents can maintain their boat docks.

On April 26, 1963, the dam was inspected by John J. Mozzochi & Associates, civil engineers, whose recommendations that settlement in the vicinity of the drawdown pipe and replacement of displaced riprap and concrete slabs should be corrected were carried out in 1964 (Appendix B).

April 25, 1974 the dam was inspected by Buck & Buck, engineers, who reported that: (1) many sections of concrete slab slope paving had slipped into the pond, and (2) concrete slabs in the mid-section of the spillway were cracked and were settling (Appendix B).

Inspections by State personnel on August 1, 1973 and April 12, 1977 also noted cracks in the concrete spillway, slope paving displaced (allegedly by ice) and excessive brush in the outlet channel.

2.4 Evaluation

a. Availability

Insufficient data has been recovered for an assessment of the safety of the embankment. Correspondence, photographs and sketches concerning the dam, particularly over the 1938-1944 period of failure and reconstruction, supplemented by the visual observations of the inspection team, form the basis for the information presented in this report.

b. Adequacy

The lack of in-depth engineering data precludes a definitive review and assessment of the adequacy of this dam. The evaluation is based primarily on visual inspection and engineering judgment, while taking into account the history and past performance of the dam.

c. Validity

The validity of the engineering data acquired covering the dam and spillway structure is considered acceptable and is not challenged.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of the Lower Bolton Lake Dam took place on 25 September 1978. The dam is in fair condition. Slope protection on the upstream face has been displaced and the downstream face is covered with brush. The spillway crest structure is considerably cracked and the individual concrete slabs have unequal vertical offsets and displacements. The downstream channel is heavily overgrown with trees and brush.

b. Dam

The dam consists of an earth dike with a spillway on the left abutment. The dike shows no evidence of horizontal or vertical movement. No evidence of seepage was observed on the downstream slope of the dike embankment, including the area between the outlet structure and the spillway, where the 1938/41 breaches occurred. The toe on the right abutment is damp but there is no indication of any significant seepage. The downstream slope is generally overgrown with brush of the order of 3 ft. to 4 ft. high (Appendix C, Photo No. 1). Between the spillway and the angle point in the dike, the lower part of the upstream slope is protected with cobble riprap mostly under 2 ft. dia., while the upper part is covered with concrete slabs (Appendix C, Photo No. 2). Between the angle point and the right abutment all the slope protection consists of concrete slabs. Some of these have been sliding down the slope (Appendix C, Photo No. 3). About 75 ft. to 80 ft. right of the outlet structure there is a noticeable gully in the upstream slope between 1 ft. and 2 ft. deep and 35 ft. to 40 ft. long. There is a second, smaller gully about 20 ft. long and 1 ft. deep in the concrete slab slope protection slightly left of the intake structure. Some riprap is missing in this vicinity.

c. Appurtenant Structures

1. Spillway

The spillway is located at the left abutment of the dam. It consists of a relatively flat 200 ft. long overflow sill and apron discharging into a 90 degree curved converging excavated channel to direct outflow back to the river near mid-length of the dam.

The crest of the overflow sill is about 5.5 feet below the top of the dam. The sill slopes gradually both upstream and downstream from its crest, dropping about 5 inches in a 5 ft. distance to its upstream edge and 2.5 feet in a 10 ft. distance to its downstream edge. Cutoffs 5 ft. deep are provided at both the upstream and downstream edges of the concrete overflow apron. A steel sheet piling cutoff has also been installed at the upstream edge of the apron, which was added after the concrete sill was built, in order to reduce seepage through the spillway foundation. It is recorded that the steel piling was driven to refusal, but it is not known if it penetrated to bedrock.

Hand laid riprap has been placed both upstream and downstream from the apron. The upstream riprap appears to be mostly in place; the downstream riprap has been displaced or scoured away in many areas. The apron concrete has been constructed in 10 ft. wide separate sections, and apparently without reinforcement either in the slabs or across the joints. As a consequence some of the sections show cracks completely through the concrete and many of the sections are displaced vertically with respect to each other, with joints offset as much as 2 to 3 inches. There is also some spalling and deterioration of the concrete wing walls (Appendix C, Photo Nos. 5, 7 & 8).

2. Outlet Pipe

An examination of the downstream slope of the dam around the perimeter of the outlet pipe and in that vicinity showed no wet areas or seeps of consequence, and it is to be assumed that compaction around the outside of the pipe has been adequate to forestall piping. No terminal outlet structure where the pipe emerges from the dam is provided, the jet discharging directly into an unlined outlet channel. However, no serious erosion has occurred in this discharge channel.

The valve for regulating outlet discharges is installed at the upstream end of the pipe, operated by a long key lowered through a hole in a riser structure located opposite the toe of the dam. There is some difficulty in operating the valve even at normal reservoir levels, since access to the riser is only by boat.

d. Reservoir Area

An inspection of the reservoir shore revealed no evidence of sliding or sloughing or other ground instability for a distance of several thousand feet upstream of both left and right abutments.

e. Downstream Channel

The spillway discharges into a 90 degree curved excavated channel which connects to the main channel of Bolton Pond Brook. This channel is approximately parallel to the dam axis and is excavated in earth, with the right side of the channel cut as close as 50 ft. to the toe of the dam. The channel is heavily overgrown with brush and trees and was barely distinguishable (Appendix C, Photo No. 6). Bolton Pond Brook crosses Alternate Route 44 about 1,000 ft. downstream from the dam.

3.2 Evaluation

The visual inspection of the dam revealed reasonably adequate information, sufficient to make an assessment of those features relating to the safety and stability of the structure. The dam is judged to be in fair condition, as are appurtenant works.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The CT Department of Environmental Protection, Region 3, operates the dam on an ad hoc basis. There appear to be no formal operating procedures. The pool is lowered a few feet in the fall if requested by owners of shoreline properties, in order to permit maintenance of boat docks.

4.2 Maintenance of Dam

According to officials of the Region 3 office, maintenance is carried out as needed by State forces.

4.3 Maintenance of Operating Facilities

The only operating facility is the 15 in. dia. valve on the upstream end of the outlet pipe. This valve is operated by a cumbersome key kept at the Region 3 office. The outlet is too small, however, to effect a significant lowering of the reservoir in anticipation of a flood.

4.4 Warning Systems

There is no formal warning system or program at this dam. A program should be developed, with sequences and responsibilities for emergency situations defined and personnel trained in its implementation.

4.5 Evaluation

Operational, maintenance and emergency warning procedures should be improved and formalized.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The evaluation of hydrologic features of Bolton Lake Dam was based on criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Accordingly, the Probable Maximum Flood (PMF) was selected to evaluate the hydraulic capacity of its spillway and channels. This selection was based on the impoundment's size and hazard potential which were adjudged to be intermediate and significant respectively. The fact that the dam has failed twice in the last 40 years, causing significant downstream damage, was another factor contributing to the selection of the PMF as the test flood.

The PMF was calculated from the Probable Maximum Precipitation (PMP) obtained from Hydrometeorological Report No. 33 utilizing the HEC-1 computer program. Precipitation values obtained from H.R. No. 33 were for a 24-hour storm over a 200 square mile drainage area. These values were adjusted for the smaller drainage area and storm duration in accordance with procedures recommended in Design of Small Dams Second Edition. In addition, the adjusted precipitation values were further modified by a "transposition factor" for "basin fit" as well as a constant loss factor for infiltration. The latter two factors were either applied to precipitation values prior to input or as direct input to the HEC-1 computer program.

Additional input to the HEC-1 program consisted of a synthetic unitgraph for the pertinent drainage area as well as the surcharge storage capacity of the lake along with the spillway discharge capacity for each corresponding storage elevation.

Inflow to lower Bolton Lake is primarily a function of the discharge from upper Bolton Lake immediately adjacent to the north. Since the area which drains directly to lower Bolton Lake represents less than 20% of the entire area contributing runoff to the lower dam, the inflow hydrograph for this lake was derived by adding the direct precipitation on lower Bolton Lake and its drainage area to the discharge hydrograph resulting from the test flood routed through upper Bolton Lake. The PMF from the upper lake's 3.07 square miles of drainage area was calculated and routed through the lake utilizing the HEC-1 program (see printouts, Appendix D, pages D-34 thru D-50.

During a PMF event, peak inflow to upper Bolton Lake would occur about 4.75 hours after the start of the storm and reach a magnitude of 11,100 cfs. Detention in the lake reduces this peak to about 6,600 cfs which would be discharged directly into lower Bolton Lake. Peak discharge from upper to lower Bolton Lake would occur approximately 6 hours after the start of the storm.

The discharge hydrograph for upper Bolton Lake was combined with precipitation on lower Bolton Lake to produce an inflow hydrograph for the lower lake. The combined hydrograph exhibited two inflow peaks at time intervals 4 and 5.5 hours into the storm. These peaks, whose magnitudes are 6,700 cfs and 7,700 cfs respectively, are reduced by routing through the lower lake to a single broad peak of 6,400 cfs. Peak discharge from lower Bolton Dam occurs 6.5 hours after the start of the storm reaching a flood stage height 4.5 feet above the spillway crest. At the time of peak discharge, there will still be 1.0 feet of freeboard between the surface of the lake and the crest of the dam. Thus, overtopping of the dam would not appear to be a very viable likelihood at lower Bolton Lake Dam, except possibly from wave action.

The results obtained utilizing the HEC-1 program were verified manually. The manual analysis is included in Appendix D, pages D-2 thru D-17.

b. Experience Data

There are no gauging stations in the immediate vicinity of Bolton Lake, its tributaries or downstream channels. However, there is a rain gauge at Shenipsit Lake just a few miles upstream and considerable documentation of downstream floods caused by previous failures of Bolton Lake Dam. As described in Section 1.1-b., Bolton Lake Dam failed during a hurricane in September 1938, at which time the Hartford Weather Bureau 12 miles to the west of the lake recorded 6.72 inches of rainfall in 24 hours. At the time of the failure, the dam was three feet lower than its present elevation and the spillway was only fifteen feet wide. No information is available with respect to the flood stage at the spillway at the time of the failure although the breaching of this dam is said to have been "triggered" by failure of the upper dam.

The dam and spillway were rebuilt with work being terminated early in May, 1941. Apparently the reconstruction was not carried out in accordance with the design approved by the War Department. Shortly thereafter, piping developed in the vicinity of one of the original breaches and on June 9, 1941, a large section failed a second time. The 1941 failure was apparently caused by poor construction procedures although heavy rains had fallen in the vicinity all of the preceding week. There is no record of the water stage in the lake at the time of the 1941 failure although reputedly it had reached the low point of the spillway crest.

A major storm for which there is some hydrologic documentation occurred in June 1944 after the dam had been rebuilt a second time. During this storm, the Rockville Water & Aqueduct Company recorded 5 inches of rainfall in a 6 hour period. A hydrograph prepared by the USGS at that time (see Appendix D, page D-31) indicates that discharge at the lower dam peaked at about 225 cfs as a result of this storm. A discharge of that magnitude would produce about 0.5 feet of water over the spillway crest. It is reported that this discharge caused considerable damage to downstream property owners, in the form of local erosion and muddy water affecting industrial users.

c. Visual Observations

1. General

The concrete spillway has many cracks and steps at construction joints of up to 3 in. The downstream channel is heavily overgrown with trees and brush, which could retard and back up flows to the extent that the spillway capacity could be affected. The 15 in. dia. outlet pipe has a maximum discharge with the valve open estimated at less than 15 cfs. This discharge would have little effect on total outflow during flood releases.

2. Upstream Damage Potential

The Bolton Lakes reservoirs and adjoining areas are popular recreational and summer home sites and many residences have been built along the lake shores. Although a detailed survey was not made of the total number of houses ringing the reservoirs nor their exact relationship with respect to lake levels, the 1972 revised issue of the USGS guadrangle sheet shows that many of the houses may be situated below the level of the tops of the dams. During high runoff events where surcharge storage would accumulate in the reservoir freeboard space there

would be no question that some of those homes would be partly inundated. It thus appears that although the dam structure is adequate to accommodate the high magnitude floods, a major hazard would be the flooding of homes built within the freeboard range below the tops of the dams.

To ameliorate the hazard to upstream interests, there appear to be no remedial measures insofar as the Bolton Lakes Project is concerned short of emptying the reservoirs in anticipation of floods and utilizing the available storage for flood control. If such a procedure were deemed feasible or appropriate, a much larger outlet capacity than is now available would be needed to draw down the reservoirs in reasonable time before an expected flood event.

d. Overtopping Potential

The spillway capacity of lower Bolton Lake Dam is about 8,400 cfs with the lake level at maximum pool elevation (top of Dam). As indicated in Section 5.1-a., the test flood when routed through the lake has a peak discharge of about 6,400 cfs which corresponds to 4.5 feet of water over the spillway crest. With the lake surface at that level, there would still remain 1.0 feet of freeboard to the crest of the dam. Accordingly, the spillway capacity of lower Bolton Lake Dam is considered adequate to accommodate the test flood with little likelihood of dam overtopping.

In conjunction with the foregoing, it should be noted that the spillway capacity of the dam on upper Bolton Lake is also capable of accommodating the test flood without overtopping, thus eliminating the possibility of failure of the upper dam due to overtopping. This fact significantly reduces the possibility of a flood of water entering the lower lake which could not be accommodated by the lower dam.

e. Drawdown

The only drawdown capability at Bolton Lake is provided by a valve-regulated 15 inch diameter C.I. drain whose entrance invert elevation is 658 MSL. Utilizing this drain it would require about 52 days to lower the lake from spillway crest elevation 667 to the invert of the drain at elevation 658. The average drawdown rate for the uppermost five feet of lake surface is 4.5 days for each foot of drawdown.

f. Downstream Hazard

The Bolton Pond Brook stream valley immediately below the dam is about 800 feet wide but quickly narrows into a restricted reach for about the next 1½ miles where it meets the Hop River. The Hop River valley continues through a narrow section for about 1½ miles downstream from that confluence, where the valley then widens and flattens. A profile and cross sections at selected points along the stream as obtained from the USGS quadrangle sheet are plotted on Plate 11 in Appendix D. Assuming a coefficient of roughness 'n' of 0.10 (rivers with fairly regular alignment and cross section, heavily obstructed by small trees and underbrush), stage-discharge curves at these selected stations were computed (Plate 12, page D-17). Plotted on Plate 11 are the computed water surface profiles for 6,500 and 12,300 cfs flows along this stream reach (page D-16).

Although the dam at lower Bolton Lake can accommodate the test flood, a discharge of approximately 6,500 cfs will inundate portions of the downstream channel, particularly in the area upstream from the Rt. 44A bridge crossing. The maximum flood at this constriction will reach a stage height 16 feet above the river bed as indicated on the downstream flood stage curves in Appendix D. Also depicted are the downstream flood stages assuming a 100 ft. long section of the dam fails and is breached. Maximum stage height for this condition would be 18.5 ft. at the Rt. 44A bridge. This would affect a few homes and commercial establishments in the immediate vicinity.

The lateral extent of both downstream flood conditions are indicated on the USGS topographic map in Appendix D which depicts the drainage area and downstream flood hazard areas (page D-1).

With one or two exceptions, residences built along the Hop River Road about 2 miles downstream appear to be above the flood plain for a breach failure outflow down the river (Appendix D, Plate 12, page D-17). However, the Alternate Route 44 bridge crossing 1,000 ft. downstream from the lower dam would be vulnerable to overtopping by outflows of more than about 2,800 cfs magnitude. It thus appears that the downstream interests would be safe against inundation for floods up to the PMF or over with a breach in the dam, except that such outflows would be augmented by added inflows along the Bolton Pond Brook river course and by inflow from the Hop River drainage basin.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The field investigation of the earth embankment revealed no significant displacements or distress which would warrant the preparation of slope stability computations based on assumed soil properties and engineering factors. Data on the engineering characteristics of the embankment material is lacking although some limited grain size analysis of embankment material indicates the soil to be relatively impervious.

b. Design and Construction Data

The original dam was constructed about 1856. No plans or calculations were recovered regarding the original design. After the dam was breached in 1938, a design for reconstruction was prepared by the CT Department of Public Works. The only plan recovered was Sheet No. 1, Spillway Lower Dam Bolton Lakes, which is included in Appendix B. No calculations of stability for the design were found in the records examined.

The dam was reconstructed in 1940-41, but it appears that the approved design for the embankment, which included raising it 3 ft. and widening the top to 10 ft., was not followed. It does appear, however, that the approved design for the spillway was followed, although the construction was evidently not very well performed.

After the dam was breached for the second time in 1941 there were a series of repair and reconstruction operations. No plans or calculations of value to a stability assessment were recovered for any of these operations over the period of 1941-44. From the correspondence files, however, it appears that the dam was raised and widened to essentially the design section approved by the War Department in 1939. The reconstructed embankment sections were provided with a steel sheet and concrete core, and seepage under the spillway was cut off with steel sheet piles.

The only reconstruction work since 1944 appears to have been replacement of displaced riprap and concrete slabs on the upstream face of the embankment in 1964.

c. Operating Records

No pertinent operating records appear to exist for this dam.

d. Post Construction Changes

The original dam was breached in 1938, reconstructed, breached again in 1941 and reconstructed essentially as it exists today in 1941-44. These events are fully described in Section 1-h.

The reconstruction of the dam accomplished in 1941-44 should not adversely affect the stability. The results of the field inspection and a check of the available records produced no evidence of other changes which might influence stability.

e. Seismic Stability

The dam is located in Seismic Zone No. 1 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

On the basis of the Phase I visual examination, the dam appears to be in fair condition and functioning adequately. The deficiencies revealed are not of major concern but tend to indicate that a consistent maintenance program is needed. The spillway capacity is adequate to pass the test flood without overtopping the dam.

Though no detailed survey was undertaken, from visual observations it appears that the abutment area to the left of the left spillway inlet wall is at a lower level than the top of the main dam, and that at the right abutment of the dam where the approach street and boat ramp leads into the reservoir there is a length along the left side of the road downstream from the dam which appears lower than the level of the dam crest. Although it is concluded that the dam would not be overtopped by the test floods studied, it is possible that if the abutment saddles are lower as suspected, that they would be vulnerable to overtopping and breaching. If further study proves that such is the case, it would be prudent to close off these low areas with dikes, to bring the abutments up to or higher than the level of the main dam.

The concrete overflow slabs comprising the spillway crest structure are considerably cracked and the individually constructed sections show some unequal vertical offsets and displacements, either from heaving owing to freeze and thaw action or from settlement. Although the downstream earthen channel now shows no deep scouring, minor scour channels below initial grade and some displacement of riprap are in evidence. The channel is heavily overgrown with trees and brush, which would retard and back up flows to the extent that the spillway capacity could be affected.

It would not be expected that serious damage to the overflow structure or to the downstream channel would occur during small discharges over the crest. However, with outflows approaching that of a 1/2 PMF magnitude, it is possible that some of the separately articulated and presumably loosely bedded sections could be displaced and washed away, thereby

causing an incipient breach along the spillway length. Also, high velocity flows in the downstream unlined channel could result in excessive erosion along the upstream side near the toe of the dam, thereby threatening the safety of the toe of the main embankment.

b. Adequacy of Information

The information recovered is considered adequate for the purpose of making an assessment of the performance of the dam.

c. Urgency

The dam appears to be in no immediate danger of becoming a hazard to life and property. The recommendations and remedial measures enumerated below should be implemented by the owner within one year after receipt of the Phase I Inspection Report.

d. Need for Additional Investigation

Additional investigations are required as recommended in Para. 7.2. It is recommended that Upper Bolton Lake Dam be included in future studies.

7.2 Recommendations

It is recommended that the owner should retain the services of a competent registered professional engineer to determine abutment saddle elevations and develop any necessary dike designs to close off possible low areas. The feasibility of providing a larger capacity outlet pipe or other suitable outlet works for lowering the reservoir level should also be investigated.

7.3 Remedial Measures

Existing deficiencies should be corrected by the owner during the next available construction season. The principal requirements are:

1. Remove all brush and trees from upstream slope, downstream slope and downstream channel, keeping downstream toe visible for inspection of seepages.

2. Monitor cracks in concrete spillway and wing walls and make repairs if any worsen.

3. Reinstate riprap and concrete slab protection on upstream slope, filling in gullies in the process.

4. Monitor wet area along toe of downstream slope periodically during periods of high reservoir level and at least once a year.

5. Develop a formal flood warning system and adopt an operational procedure to follow in the event of an emergency.

a. Operation & Maintenance Procedures

The owner should institute procedures for a biennial periodic technical inspection of the dam and appurtenant works, with supplementary inspections of any suspect items. A checklist for periodic inspections should be developed and records should be kept of all maintenance and repair work performed. Ordinary maintenance, such as cutting brush and repairing concrete structures, should be carried out in accordance with a regular and consistent program.

7.4 Alternatives

Since the spillway is adequate to pass the test flood without overtopping the dam, there are no appropriate alternatives to these recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION
PHASE I

Identification No. 00509 Name of Dam: Bolton Lake Dam (Lower)

Date of Inspection: 25 September 1978

Weather: partly cloudy Temperature: 65°F ±

Pool Elevation at Time of Inspection: 665.5

Tailwater Elevation at Time of Inspection: 652.5

INSPECTION PERSONNEL

Peter B. Dyson	Louis Berger & Associates, Inc.	Project Manager
Carl J. Hoffman	Louis Berger & Associates, Inc.	Hydraulics, Structures
Thomas C. Chapter	Louis Berger & Associates, Inc.	Hydrology, Soils
William S. Zoino	Goldberg Zoino Dunnicliff & Assoc., Inc.	Soils

OWNER'S REPRESENTATIVES

Charles Phillips	Connecticut Department of Environmental Protection, Region 3	Fishery Biologist
Guy Hoffman	Connecticut Department of Environmental Protection, Region 3	Fishery Biologist Research Assistant

STATE REPRESENTATIVES

Paul Bisanti	Connecticut Department of Environmental Protection, Flood Management Section, Water Resources Unit	Civil Engineer
Michael Sanders	Connecticut Department of Environmental Protection, Flood Management Section, Water Resources Unit	Seasonal Maintainer
Steven Derby	Connecticut Department of Environmental Protection, Flood Management Section, Water Resources Unit	Engineering Aide

VISUAL INSPECTION CHECKLIST

Identification No. 00509 Name of Dam: Lower Bolton Lake Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
EMBANKMENT Vertical alignment and movement	None evident except as noted below.
Horizontal alignment and movement	None evident except as noted below.
Unusual movement or cracking at or near the toe	None evident.
Surface cracks	None evident
Animal burrows and tree growth	No burrows observed. No mature trees but brush growth on both slopes, particularly downstream
Sloughing or erosion of slopes	None except where caused by footpaths down the slope, near spillway and near outlet pipe.
Riprap slope protection	2 rows of precast concrete slabs placed on upper portion of upstream face with riprap protection at and near normal reservoir level. Precast slabs are displaced with upper row overriding lower row and lower row overriding riprap, for most of (continued next page)

VISUAL INSPECTION CHECKLIST

Identification No. 00509 Name of Dam: Lower Bolton Lake Sheet 2

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Riprap slope protection (continued)	length of dam. Displacement may be caused by a slumping of the embankment, by freeze & thaw action or by improper bedding during placement. Embankment does not show signs of slumping, and appears sound under slabs.
Seepage	Slight evidence downstream from dam, but no measurable flow.
Piping or boils	None evident.
Junction of embankment and abutment, spillway and dam	No problems evident.
Foundation drainage	None evident.
OUTLET WORKS Approach channel	None.
Outlet conduit concrete surfaces	None.
Intake structure	Not visible except for concrete housing to valve stem.

VISUAL INSPECTION CHECKLIST

Identification No. 00509 Name of Dam: Lower Bolton Lake Sheet 3

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Outlet structure	15" Ø C.I. pipe.
Outlet channel	Natural stream.
Drawdown facilities	Manual valve in 15" Ø C.I. pipe.
<u>*SPILLWAY STRUCTURES*</u> Concrete weir	Many cracks and steps at construction joints up to 3" due to settlement or heaving. Concrete surfaces fair to good except for localized freeze & thaw damage.
Approach channel	None.
Discharge channel	Overgown with heavy brush and trees. Riprap below concrete overflow not continuous with riprap missing in scour channels.
Stilling basin	None.
Bridge and piers	None.

VISUAL INSPECTION CHECKLIST

Identification No. 00509 Name of Dam: Lower Bolton Lake Sheet 4

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Control gates and operating machinery	None.
INSTRUMENTATION Headwater and tailwater gages	None.
Embankment instrumentation	None.
Other instrumentation	None.
RESERVOIR Shoreline	Wooded with extensive housing development. West, steeply sloping. East, gently sloping. Appears stable.
Sedimentation	None observed.
Upstream ·ızard areas in event of backflooding	Houses close to shoreline on east side appear to be in surcharge freeboard area below elevation of top of dam.
Alterations to watershed affecting runoff	No recent alterations noted.

VISUAL INSPECTION CHECKLIST

Identification No. 00509 Name of Dam: Lower Bolton Lake Sheet 5

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
<u>DOWNSTREAM CHANNEL</u> Constraints on operation of dam	Route 44A bridge 1,000 ft. downstream.
Valley section	Narrow V-shaped canyon type valley from 1,000' downstream to 2¼ miles downstream.
Slopes	5%±, wooded.
Approximate number of homes/population	3 houses immediately downstream of west end of dam. 4 houses, gas station, offices, Montessori School off Route 44A. Many homes along Hop River Road about 2 miles below dam which are in the river floodway for flows exceeding about 1000 cfs.
<u>OPERATION & MAINTENANCE FEATURES</u> Reservoir regulation plan, normal conditions	No formal plan. Lake usually lowered each fall at request of residents for dock maintenance.
Reservation regulation plan, emergency conditions	No formal plan.
Maintenance features	At discretion of Region 3 Manager, Department of Environmental Protection.

APPENDIX B

PLANS, RECORDS & PAST INSPECTION REPORTS

APPENDIX B

1. Design, construction and maintenance records and their location.

All data recovered was found in the files of:

Water & Related Resources Unit
Department of Environmental Protection
State Office Building
Hartford, CT 06115

Only two drawings were located and copies of both are included herein:

- Plan and Profile of Lower Dam, October 1939
- Spillway Lower Dam, December 29, 1939

The voluminous correspondence files covering the period from the initial failure of the dam in September 1938 to the present include the following data:

- The War Department required a spillway capacity of 2800 c.f.s.
- Reports of visits by officials of State Board of Supervision of Dams to the reconstruction work performed at various times by a number of organizations between 1940 and 1944.
- Photographs taken on March 24, 1941.
- Photographs taken on June 10, 1941, after the second failure of the dam.
- Report by Chandler & Palmer dated April 20, 1943, copy included herein.
- Photographs taken on August 16, 1943.
- Photographs taken on December 29, 1943.
- Details of repairs carried out in 1964.
- Photographs taken on August 1, 1973.

2. Copies of past inspection reports.

- John J. Mozzochi & Associates, May 1, 1963
- Buck & Buck, May 8, 1974

3. Plans and boring logs.

- Plan and Profile of Lower Dam, October 1939
- Spillway Lower Dam, December 29, 1939

Shepard B. Palmer
Benjamin H. Palmer, Jr.

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Rooms 114-116 Thayer Building
Telephone 2255

Members American and Connecticut Societies
of Civil Engineers

Dams
Water Supplies
Sewerage
Appraisals
Reports
Surveys

NORWICH, CONN.
April 20, 1943

RECEIVED
APR 20 1943
STATE WATER COMMISSION

Handed in
S. M. Palmer

Mr. Fred R. Zeller
Comptroller
State Capitol
Hartford, Connecticut

Attention: Mr. W. Ellery Allyn, Deputy Comptroller

Dear Sir:-

The report on the condition of the Bolton Dams as asked for in your letter of March 19, 1943 is herewith submitted.

The larger part of the time spent in preparing the report was spent in finding out just what had been done on the dams by the Public Works Department since their failure in the Hurricane of 1938. I obtained from the Public Works Department a number of blue-prints, some showing the way the dam was repaired and some showing suggested ideas which apparently were not adopted. There was some difference of opinion among those with whom I talked about details of construction, and my recommendations are based on what I hope are the facts. To review briefly the history of the dams, it is known that before and during the flood of 1938 the two dams and the ponds were the property of the Connecticut Light & Power Company and others. After the failure of the dams the owners decided not to rebuild and presented them to the State together with flowage rights and appurtenances. The Lower Dam is in the Town of Bolton and the Upper Dam is in the Town of Vernon. When both ponds are full to the spillway height, the surface of the water in the upper pond is about 6 feet above the surface of the water in the lower pond. The lower pond has a much larger surface area than the upper pond which is long and narrow. From the topographical maps made in 1890, the drainage area of the lower pond is between 4½ and 5 square miles and that of the upper pond a little over 3½ square miles.

From information gathered, during the Hurricane of September, 1938, the Upper Dam was overtopped and an opening made in the embankment from 50 to 60 feet wide. This let the water from the upper pond flow into the lower thereby causing the lower dam to be overtopped in two places and causing the embankment to be scoured out at least to the level of the bottom of the pond. These two breaks were on the Westerly half of the embankment of the lower pond. Many cottages had been built along the shore of these ponds and they were left with no pond and the pond area was filled with unsightly stumps. The 1939 Legislature appropriated the sum of $15,000 to repair the dams and the balance

was to be furnished by the W. P. A. The Public Works Department of Connecticut made up a project in 1940 for the expenditure of about $47,000 for labor and material. This work was started in 1940. The break in the Upper Dam was filled in 1940 and part of the water was being passed through the 15" waste pipe into the lower pond. The two breaks in the lower pond were also repaired in 1940. No sheeting of any kind was used in this repair work on either dam. The fill on the lower dam for the most part was taken from the bottom of the pond and much of it was mud, so that a bulldozer which was trying to roll the fill which had been placed in one of the breaks in the lower dam became mired in the material that had been used to repair the break and the operator was unable to extracate the bulldozer with its own power. I happened to be on the dam at this time and saw the plight of the operator when he was unable to work out of the muddy fill which had been placed.

The Easterly of the two sections on the lower dam, which had been filled gave way on June 9, 1941. The local people reported that this began with a leak which gradually increased and suddenly the whole section slid out, flooded the highways and meadows, carrying mud, silt, etc. downstream even as far as tide-water below the City of Norwich.

After that wash out I saw a good cross section of the material used in the original embankment at the lower dam. The natives who did that job knew how to make a tight embankment with enough clay so that after the failure the edges of the washed out sections stood up vertically for 10 or 12 feet. There were no leaks through that embankment.

After the lower dam failed in 1941 The Jarvis Construction Co. of Manchester, Connecticut, were employed to make the repairs under the direction of the Public Works Department. Steel sheeting in the Easterly section was driven to refusal and then Mr. Jarvis was ordered to cut off the sheeting in the Easterly section to a level line substantially 10 feet below the top of the embankment or in other words about 7 feet below the surface of the water in the pond when full. The plans of the Public Works Department show a 15" draw-off pipe going through the steel sheeting. I asked Mr. Jarvis how this was done and he informed me that he burned a hole through the sheeting large enough to take the 15" pipe and then after sliding the cast iron pipe through the opening he encased the whole joint in concrete on each side of the sheeting, which should have prevented the seepage of water from following the 15" pipe.

The Westerly break in the embankment of the lower dam did not collapse when the Easterly section gave way. At the time Mr. Jarvis was repairing the Easterly section he also drove steel sheeting in the Westerly section under the direction of the Public Works Department. This section has the top of the sheeting from 2 to 3 feet below the top of the present embankment.

The section of the upper dam which was washed out in 1938 was filled in at about the sametime as the lower dam in 1940 and a 15" pipe was placed through the embankment. No sheeting was used at that time in connection with this fill but in 1941 after the collapse of the lower dam, a row of steel sheeting was installed and according to Mr. Jarvis was driven in at the edge of the water on the upstream side of the upper dam and driven to refusal.

The last work done on the dams as far as I know was in March, 1942. From correspondence in the files of the Public Works Department it appears that bad leaks developed in the spillway section of the lower dam, so much so that in March, it was recommended to Commissioner Burke that he immediately locate some steel sheeting and drive same just upstream from the upstream edge of the concrete spillway. This was done by the A. I. Savin Construction Co. and the piles were driven to refusal as shown by their tops at the present time. This evidently stopped the under-scour, which from reports was in danger of becoming serious.

When the Public Works Department started using Government funds of the W. P. A. in repairs to the dams that brought in the War Department from the District Engineer's Office in Providence, R. I. There was much letter writing and conferences between the District Engineer's Office and the Public Works Department. The Providence office made certain recommendations as to flood capacities which the dam should be designed to take care of on both the upper and lower dams. These recommendations as to length of spillway and carrying capacity were not adopted. The Public Works Department put in a concrete spillway a little over 200 feet long on the lower dam and about 150 feet long on the upper dam and made no change in the height of the embankment.

General Wadham's office discussed the run-off problem with Mr. Burke L. Bigwood of the U. S. Geological Survey who is considered an authority on flodd discharges in Connecticut and vicinity. Mr. Bigwood came to the conclusion (and recommended) that the discharge of 300 cubic feet per second per square mile should be provided for at the Bolton reservoirs, which would mean a discharge of about 1500 cubic feet per second at the lower dam and 1125 cubic feet per second for the upper dam. He also gave the opinion that in addition to the spillway capacity for the above figures, the embankment should be designed to take care of a sur-charge of about 3.3 feet. This in my opinion is quite essential, especially on the lower dam which is exposed to Northerly and Northwesterly winds and has a large pond above it. On April 7th of this year I visited this dam and the water was running over the lower spillway for a distance of about 40 feet in the center of the spillway. The top of the embankment was about 3.2 above the level of the water in the pond and the wave action caused by the wind

had thrown water clear up to the top of the embankment and was cold enough so that the ice had formed all along the paving on the upstream edge of the embankment clear to the top. If there had been a foot and a half or two feet of water going over the spillway at the sametime, it would readily be seen that the wave action might cause serious injury to the embankment. The wind on the day of the Hurricane in September, 1938, was of Hurricane velocity and came from a little West of North; as I remember standing on the upper dam of the Guilford-Chester Water Co. and watching some of the big trees blow down at the time. This same condition existed on the Bolton Dam on the same afternoon with the wind sweeping down the full length of the ponds.

The spillways on both the upper and lower dams were not level but were lower in the center by about 6 inches than on either edge and sloped from the center up to the edges on either side so that with a low flow the water goes over about one-third of the spillway. This was criticized by the War Department.

RECOMMENDATIONS

In order to make these two dams safe, in my opinion the embankments on each one should be raised to care for the run-offs as suggested by Mr. Bigwood over the existing spillways and take care of sufficient free-board, so that they will not be overtopped in the future. In the lower dam the steel sheeting which is now down so that its top is 7 feet below the surface of the water should be topped by a concrete wall 16" thick from a point 6" below the top of the sheeting to a point 2 feet above the spillway level. Both embankments on the dams should have a minimum width on top of 12 feet and the downstream edge of the embankment should be 6" higher than the upstream to prevent wash on the downstream side of the embankment. The downstream slope should be not less than 1 vertical on 2 horizontal and the upstream slope should have the stone pavement carried to the top of the embankment on the same slope as now exists. This work of raising the tight line on the dam as above described could be done more economically in July than at the present time, as the water flowing in the stream is liable to be higher at this season of year.

No estimate of the cost of this work has been made but I will make one if you so desire and let me know.

Respectfully submitted,

Shepard B. Palmer

SBP/EW

JOHN J. MOZZOCHI AND ASSOCIATES
CIVIL ENGINEERS

GLASTONBURY, CONN.
217 HEBRON AVENUE
PHONE 633-9401

PROVIDENCE 3, R. I.
200 DYER STREET
PHONE GASPEE 1-0420

JOHN J. MOZZOCHI
ASSOCIATES
OWEN J. WHITE
JOHN LUCHS, JR.
HECTOR L. GIOVANNINI

May 1, 1963

STATE WATER RESOURCES COMMISSION
RECEIVED
1963
ANSWERED ....
REFERRED ....
FILED ....

REPLY TO: Glastonbury

William S. Wise - Director
Water Resources Commission
State Office Building
Hartford 15, Connecticut

Re: Our File 57-73-41
Bolton Lake Dams
Bolton, Connecticut

Dear Mr. Wise:

In accordance with instructions from Robert McCabb, I made an inspection of the referenced dams on Friday April 26th.

There are two dams located to form an upper and lower lake with a 7 foot difference in spillway elevations. These are very substantial earthen dams, well constructed, with concrete slabs and riprap placed on the lake side for wave protection, and with concrete spillways having ample capacity and freeboards.

The drainage area comprises 2600 acres of which 560 acres are the combined areas of the lakes and a large swamp.

The only criticism I can make is that there has been a lack of maintenance to the extent that there has now occurred a growth of bushes along the earth dams and even in the spillway of the lower dam. There is also a section of about 25' in length on the lower dam, in the area of the drawdown gate, where a settlement has occurred on the lake side. This settlement should be corrected and the riprap and concrete slabs restored to protect against wave action.

These are, by far, the best constructed dams I have had the opportunity to inspect.

Very truly yours,

John J. Mozzochi

John J. Mozzochi and Associates
Civil Engineers

JJM:hk

BUCK & BUCK
E N G I N E E R S
98 WADSWORTH STREET, HARTFORD, CONNECTICUT 06106

JAMES A. THOMPSON
ROBINSON W. BUCK
LAWRENCE F. BUCK

HENRY WOLCOTT BUCK
1921-1965
ROBINSON D. BUCK
1935-1959

COMM. 5713-93

May 8, 1974

Mr. Victor Galgowski
Supt. of Dams
Water & Related Resources Section
Dept. of Environmental Protection
State Office Building
Hartford, Conn. 06106

RE: Lower Bolton ~~Notch~~ Pond Dam

Dear Vic:

This is to report on our inspection of the subject dam on April 25, 1974.

We found many sections of the concrete slab slope paving have slipped into the pond. Principle areas of displacement are near the outlet gate and at the east end of the embankment. There are also other less effected slabs near the west end of the embankment.

We also found that concrete slabs in the mid-section of the spillway are cracked and are settling.

At present, these deficiencies do not represent a safety hazard, however, they should be repaired to protect the State's investment in the structure.

Sincerely,
BUCK & BUCK

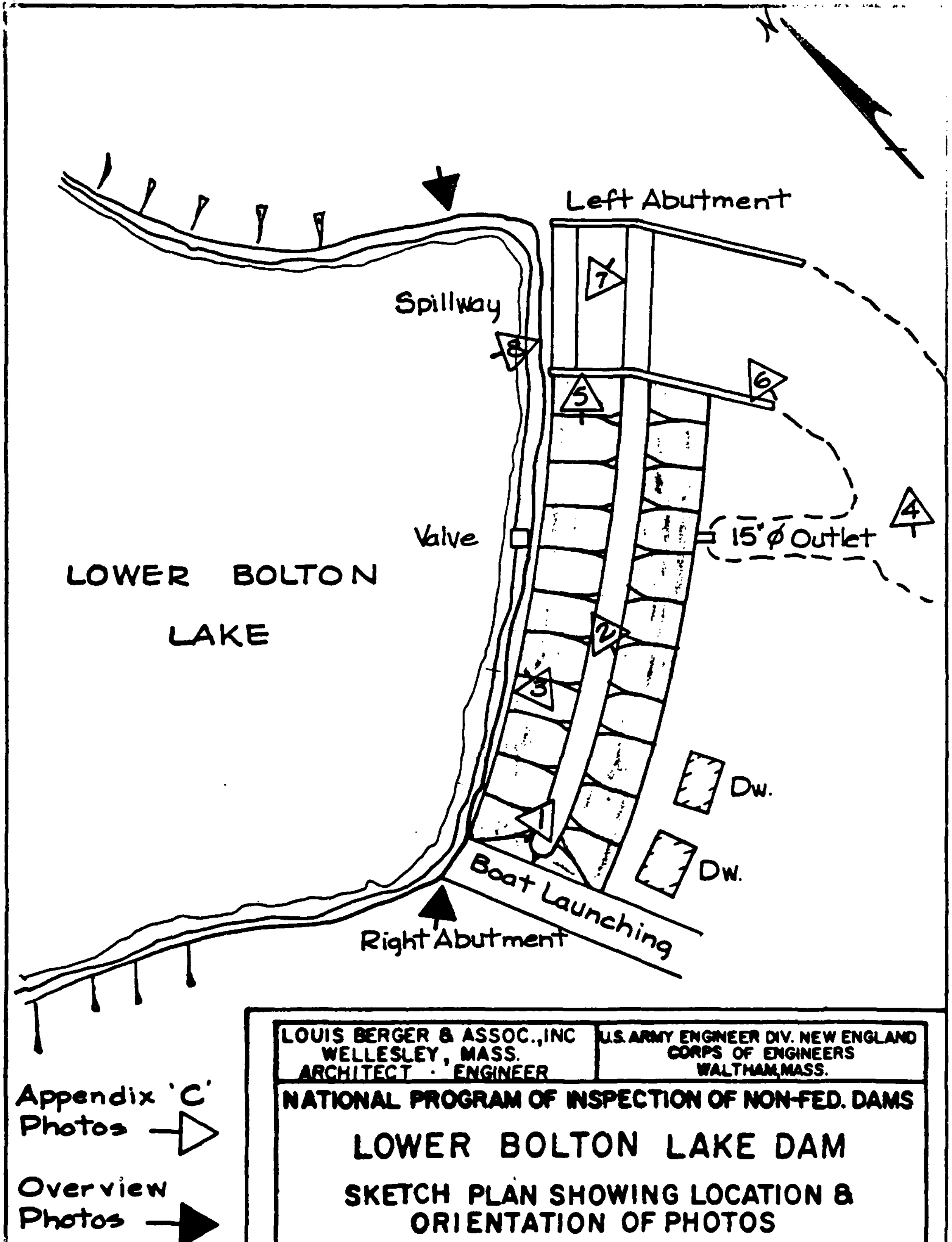
James A. Thompson

James A. Thompson

JAT:dlb

APPENDIX C

SELECTED PHOTOGRAPHS



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOWER BOLTON LAKE DAM

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

STATE - CT.

SCALE 1:24000

DATE

LOWER BOLTON LAKE DAM

1. Dike showing brush on slopes and houses downstream

2. Upstream face of dike and 15" Ø outlet valve structure

3. Cobble riprap (foreground) and displaced concrete slab slope protection

4. Downstream channel in woods below dam

5. Spillway from right wing wall

6. Overgrown channel downstream from spillway

7. Joint displacement and cracks in spillway concrete slabs

8. Steel sheet piling in upstream face of spillway

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

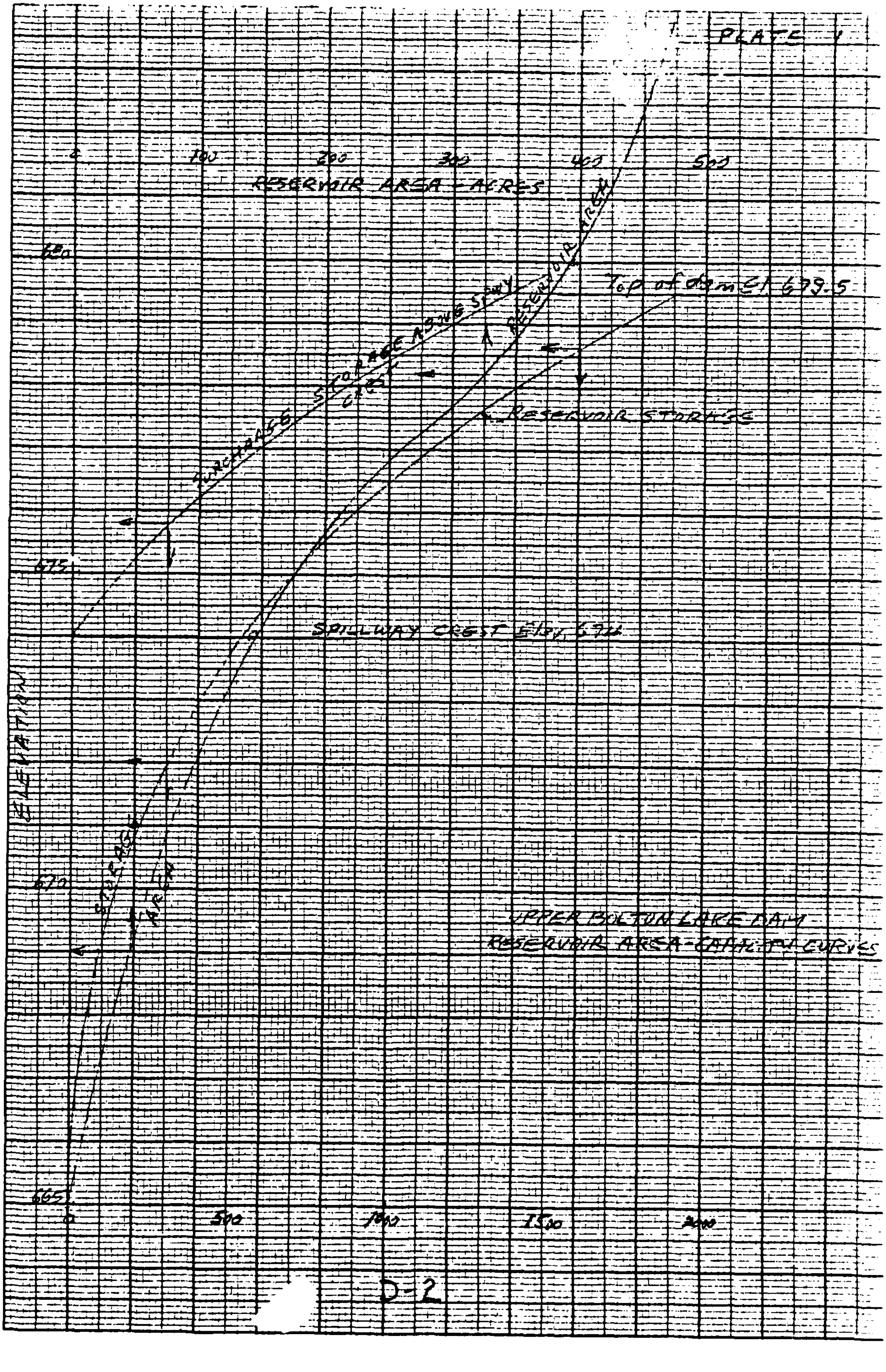


PLATE 1
0 100 200 300 400 500
RESERVOIR AREA - ACRES
680
675
670
665
ELEVATION
Top of dam El. 679.5
SURCHARGE STORAGE ABOVE SPWY CREST
RESERVOIR AREA
RESERVOIR STORAGE
SPILLWAY CREST Elev. 672
STORAGE
AREA
UPPER BOLTON LAKE DAM
RESERVOIR AREA-CAPACITY CURVES
0 500 1000 1500 2000

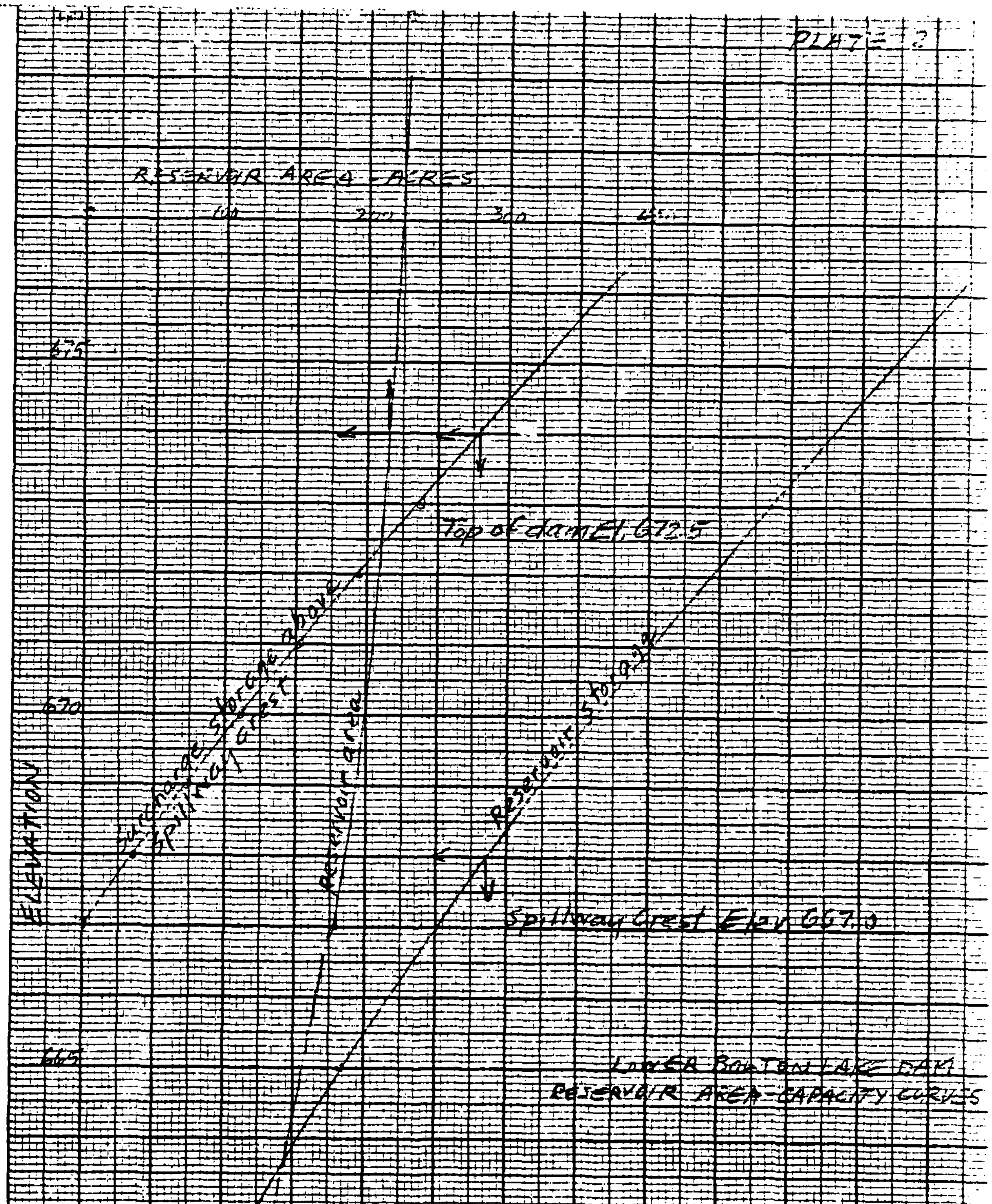


PLATE 2
RESERVOIR AREA - ACRES
100
200
300
400
675
Top of dam El. 672.5
Surcharge storage above spillway crest
Reservoir area
Reservoir storage
670
ELEVATION
Spillway Crest Elev. 667.0
665
LOWER BOLTON LAKE DAM
RESERVOIR AREA-CAPACITY CURVES
0
500
1000
1500
2000
2500
3000
RESERVOIR CAPACITY - ACRE FEET
660

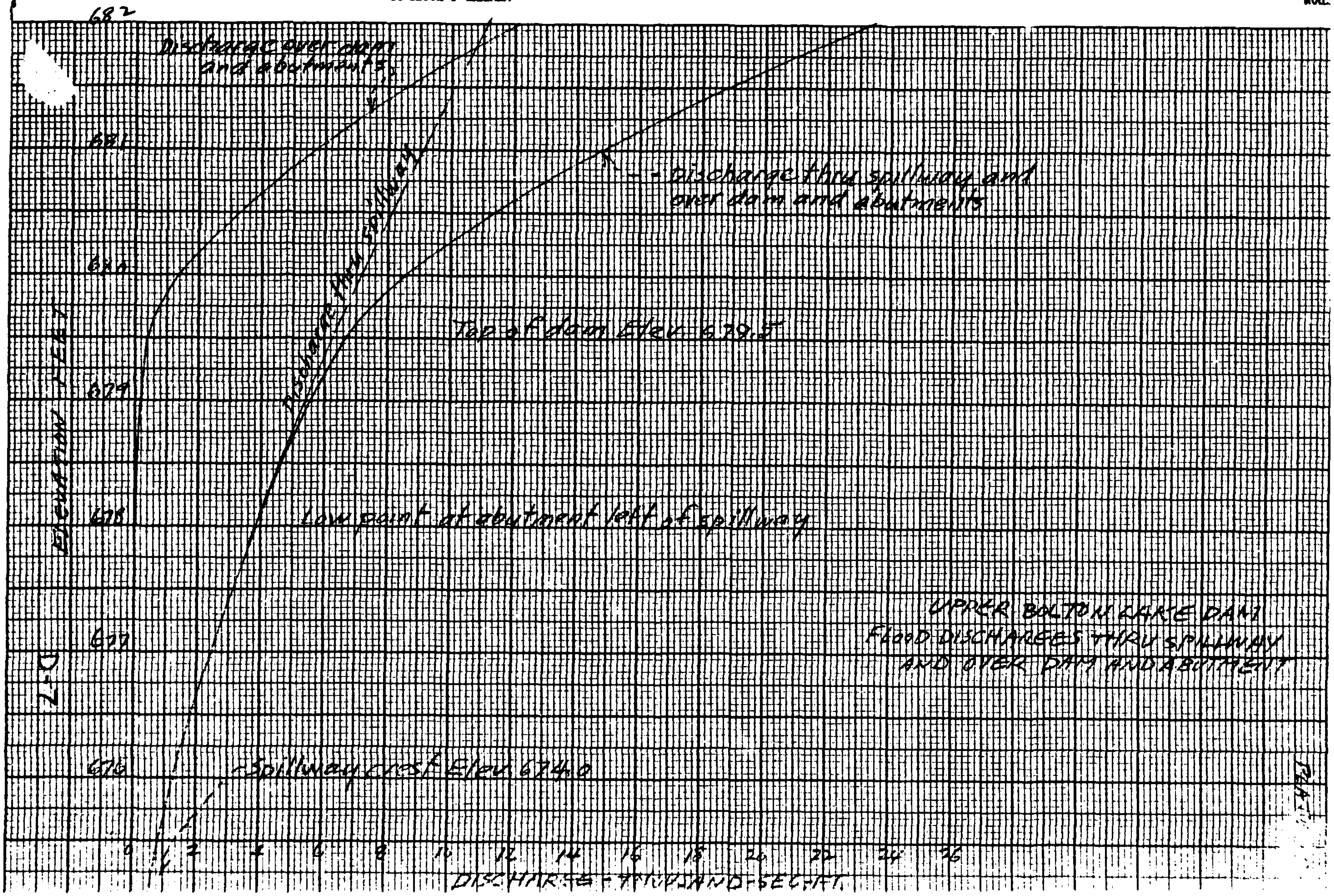
BY CJF DATE 10-12-78 LOUIS BERGER [illegible] SHEET NO. ____ OF
CHKD. BY ____ DATE ____ INSPECTION OF [illegible] PROJECT ____
SUBJECT BOLTON LAKE - RESERVOIR AREA - CAPACITY CURVES

UPPER LAKE

Elev	Planim. Area Sq in	Area acres	Ave. Area acres	Δ Vol AF	Total Storage AF	Surcharge Storage AF	
665	0	0			0		
66		10	5	5	5		
67		21	16	16	21		
68		34	27	27	49		
69		47	41	41	89		
670		62	54	54	143		
71		78	70	70	213		
72		97	88	88	301		
73		120	108	108	409		
674	1.55	142	131	131	540	0	Spillway crest El. 674
75		175	158	158	698	158	
76		213	194	194	892	352	
77		260	236	236	1129	588	
78		315	288	288	1416	876	
79		360	337	337	1753	1213	Top of dam El. 679.5
80	4.30	395	378	378	2131	1591	

LOWER LAKE

Elev.	Planimeter Area Sq. in	Area Ac.	Av. Area Ac	Δ Vol. AF	Total Storage AF.	Surcharge Storage AF	
655	0	0			0		
657		47	23.5	47	47		
659		85	66.0	132	179		
661		113	99.0	198	377		
663		136	124.5	249	626		
665		157	146.5	293	919		
667	1.92	176	166.5	333	1252	0	Spillway crest El. 667
668		185	180.5	181	1433	181	
669		193	189.0	189	1622	370	
670	2.18	200	196.5	196	1818	566	
671		205	202.5	203	2021	769	
672		209	207.0	207	2228	976	Top of dam El. 672.5
673		212	210.5	210	2438	1196	
674		215	213.5	214	2652	1400	
675		219	217.0	217	2869	1617	
680	2.51	230	224.5	1123	3992	2740	



KEUFFEL & ESSER CO.
MADE IN U.S.A.

D-7

BY CJH DATE 10-1-78 LOUIS [illegible] ASSOCIA[illegible] SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ INSPECTION OF DAMS - Co[illegible] PROJECT ____

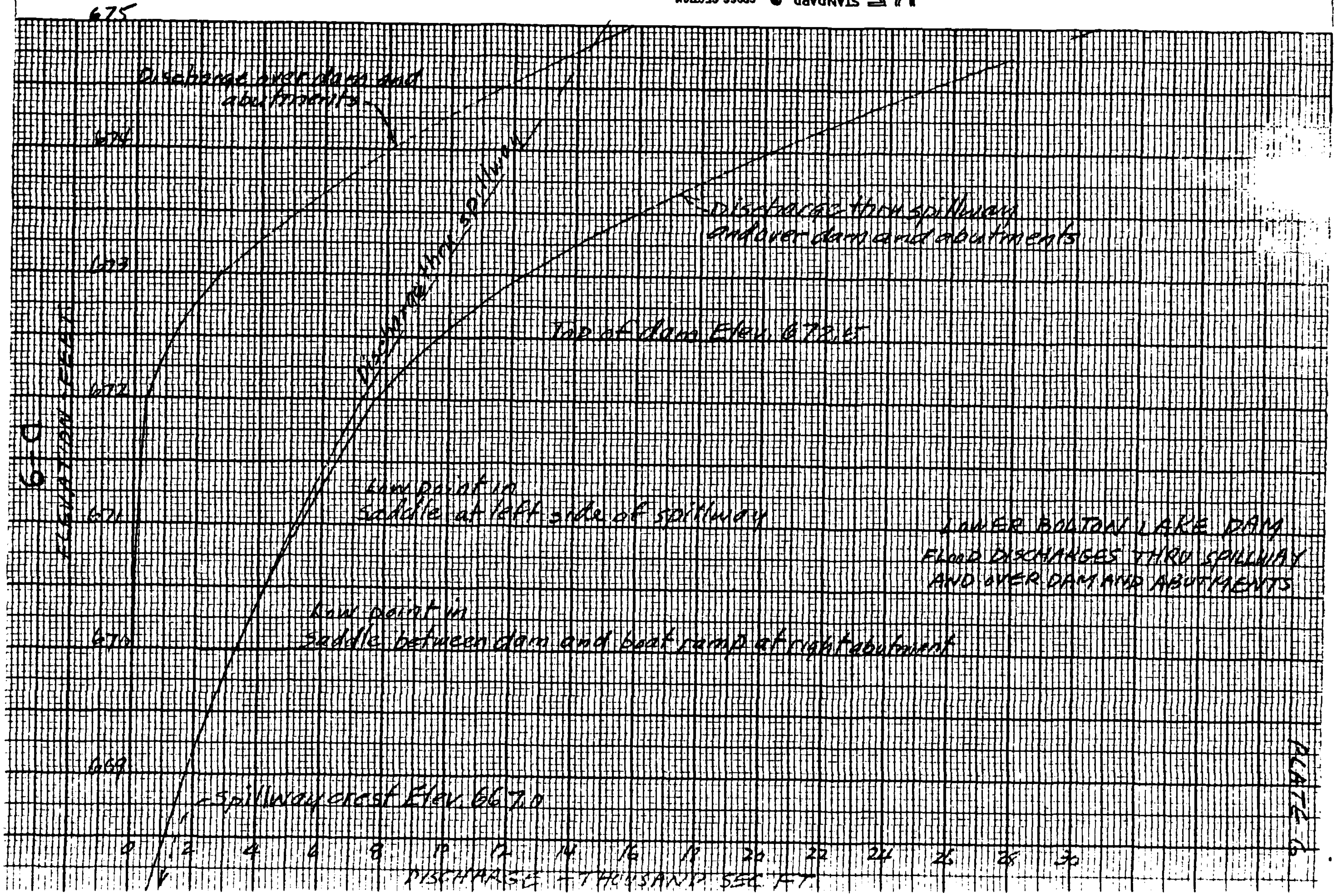
SUBJECT Bolton Lake Dam: SPILLWAY DISCHARGE CURVES

UPPER BOLTON LAKE DAM + SPILLWAY

	SPILLWAY MAIN CREST L = 147'				Sloping crest at abutments						Benches @ El 677.5 each End of spwy. crest				Total spwy Q	MAIN DAM				
Elev	Head	L	Coeff	Q	Head	Coeff	8/ft	Av/ft	L	ΔQ	Head	Coeff	L	ΔQ	Σ	Head	L	Coeff	ΔQ	ω
674.0	0	147	–	0	0										0					
675	1.0	147	3.0	441	1.0	3.0	3.00	1.50	4.57	7					448					
676	2.0	147	3.05	1268	2.0	3.0	8.48	4.24	9.14	46					1314					
677	3.0	147	3.1	2368	3.0	3.0	15.59	7.80	13.71	107					2475					
677.5	3.5	147	3.1	2984	3.5	3.0	19.64	9.82	16.0	157	0				3141					
678	4.0	147	3.1	3646	4.0	3.0	24.0	12.53	16.0	200	0.5	3.0	4.0	4	3850					
679	5.0	147	3.1	5095	5.0	3.0	33.54	19.53	16.0	312	1.5	3.0	4.0	22	5429					
679.5	5.5	147	3.1	5878	5.5	3.0	38.70	23.59	16.0	377	2.0	3.0	4.0	34	6289	0	660		0	
680	6.0	147	3.1	6697	6.0	3.0	44.09	27.97	16.0	448	2.5	3.0	4.0	47	7192	0.5	660	2.9	677	
681	7.0	147	3.1	8440	7.0	3.0	55.56	37.60	16.0	602	3.5	3.0	4.0	79	9121	1.5	660	3.0	3637	
682	8.0	147	3.1	10311	8.0	3.0	67.88	48.26	16.0	772	4.5	3.0	4.0	115	11198	2.5	660	3.05	7957	

	Dam abutment left of spillway						Summary Spillway and dam
Elev	Head	Coeff	8/ft	Av/ft	L	ΔQ	ΣQ
674.0							0
675.0							448
676.0							1314
677.0							2475
677.5							3141
678.0	0						3850
679.0	1.0	2.4	2.40	1.20	100	120	5549
679.5	1.5	2.45	4.50	2.25	150	338	Top of dam 6627
680.0	2.0	2.5	7.07	3.54	200	708	8567
681.0	3.0	2.6	13.51	6.75	300	2025	14783
682.0	4.0	2.6	20.8	10.4	[illegible]	4160	23315

D-8



LOWER BOLTON LAKE DAM
FLOOD DISCHARGES THRU SPILLWAY
AND OVER DAM AND ABUTMENTS
Discharge over dam and abutments
Discharge thru spillway
Discharge thru spillway and over dam and abutments
Top of dam Elev 672.5
Low point in Saddle at left side of spillway
Low point in Saddle between dam and boat ramp at right abutment
Spillway crest Elev 667.0
ELEVATION - FEET
DISCHARGE - THOUSAND SEC FT
675
674
673
672
671
670
669
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

PLATE 6

D-9

LOUIS BERGER & ASSOCIATES INC.

BY: CJK DATE: 10-1-78 — INSPECTION OF DAMS Conn. & R.I. — SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ PROJECT ____

SUBJECT: LOWER BOLTON LAKE DAM - SPILLWAY DISCHARGE CURVE

	SPILLWAY-MAIN OVERFLOW L = 202'				Sloping crest on left side of crest						Bench @ El 670.5 @ left end of crest				SPILLWAY	Depression to left of spillway				
Elev.	Head	L	Coeff	ΔQ	Head	Coeff	Q/ft	Av Q/ft	L	ΔQ	Head	Coeff	L	ΔQ	ΣQ	Head	Coeff	Q/ft	L	ΔQ
667.0				0	0										0					
668.0	1.0	202	3.0	606	1.0	3.0	3.00	1.50	3.71	6					612					
669.0	2.0	202	3.05	1743	2.0	3.0	6.48	4.24	7.43	32					1775					
670.0	3.0	202	3.1	3254	3.0	3.0	15.59	7.80	11.14	87					3341					
670.5	3.5	202	3.1	4100	3.5	3.0	19.64	9.82	13.0	128	0	3.0	2.0	0	4228					
671	4.0	202	3.1	5010	4.0	3.0	24.00	12.53	13.0	163	0.5	3.0	2.0	2	5175	0	2.4	0	100	0
672	5.0	202	3.1	7001	5.0	3.0	33.54	19.53	13.0	254	1.5	3.0	2.0	11	7266	1.0	2.4	2.40	100	240
672.5	5.5	202	3.1	8077	5.5	3.0	38.70	23.59	13.0	307	2.0	3.0	2.0	17	8401	1.5	2.4	4.40	100	440
673	6.0	202	3.1	9203	6.0	3.0	44.09	27.97	13.0	364	2.5	3.0	2.0	24	9591	2.0	2.4	6.79	100	679
674	7.0	202	3.1	11597	7.0	3.0	55.56	37.60	13.0	489	3.5	3.0	2.0	40	12126	3.0	2.4	12.47	100	1247
675	8.0	202	3.1	14169	8.0	3.0	67.88	48.26	13.0	627	4.5	3.0	2.0	58	14854	4.0	2.4	19.2	100	1920

	MAIN DAM				Depression at Rt end of dam									Depression left of spwy					Summary	
Elev	Head	L	Coeff	ΔQ	Head	Coeff	Q/ft	Av Q/ft	L	ΔQ	L	Q/ft	ΔQ	Head	Q/ft	Avg Q/ft	L	ΔQ	ΣQ	Elev
667																			0	667
668																			612	668
669																			1775	669
670					0	-	-	-		0	50	0	0						3341	670
670.5					0.5	2.35	0.83	0.42	8.3	3	50	0.83	42						4273	670.5
671					1.0	2.40	2.40	1.20	16.7	20	50	2.40	120	0	0				5315	671
672					2.0	2.5	7.07	3.54	33.3	118	50	7.07	354	1.0	2.40	1.20	22.2	27	7651	672
72.5	0	-		0	2.5	2.5	9.88	4.94	41.7	206	50	9.88	494	1.5	4.40	2.20	33.3	73	9614	Top of dam 672.5
673	0.5	880	2.9	902	3.0	2.5	12.99	6.91	50	346	50	12.99	650	2.0	6.79	3.40	44.4	151	12319	673
674	1.5	880	3.0	4850	4.0	2.5	20.0	12.30	50	615	50	20.0	1000	3.0	12.47	6.24	66.7	416	20254	674
675	2.5	880	3.05	10609	5.0	2.5	27.95	19.92	50	946	50	27.95	1398	4.0	19.2	9.60	88.9	853	30580	675

PLATE 7

UPPER BOLTON LAKE RESERVOIR
FLOOD ROUTING FOR PMF EVENT

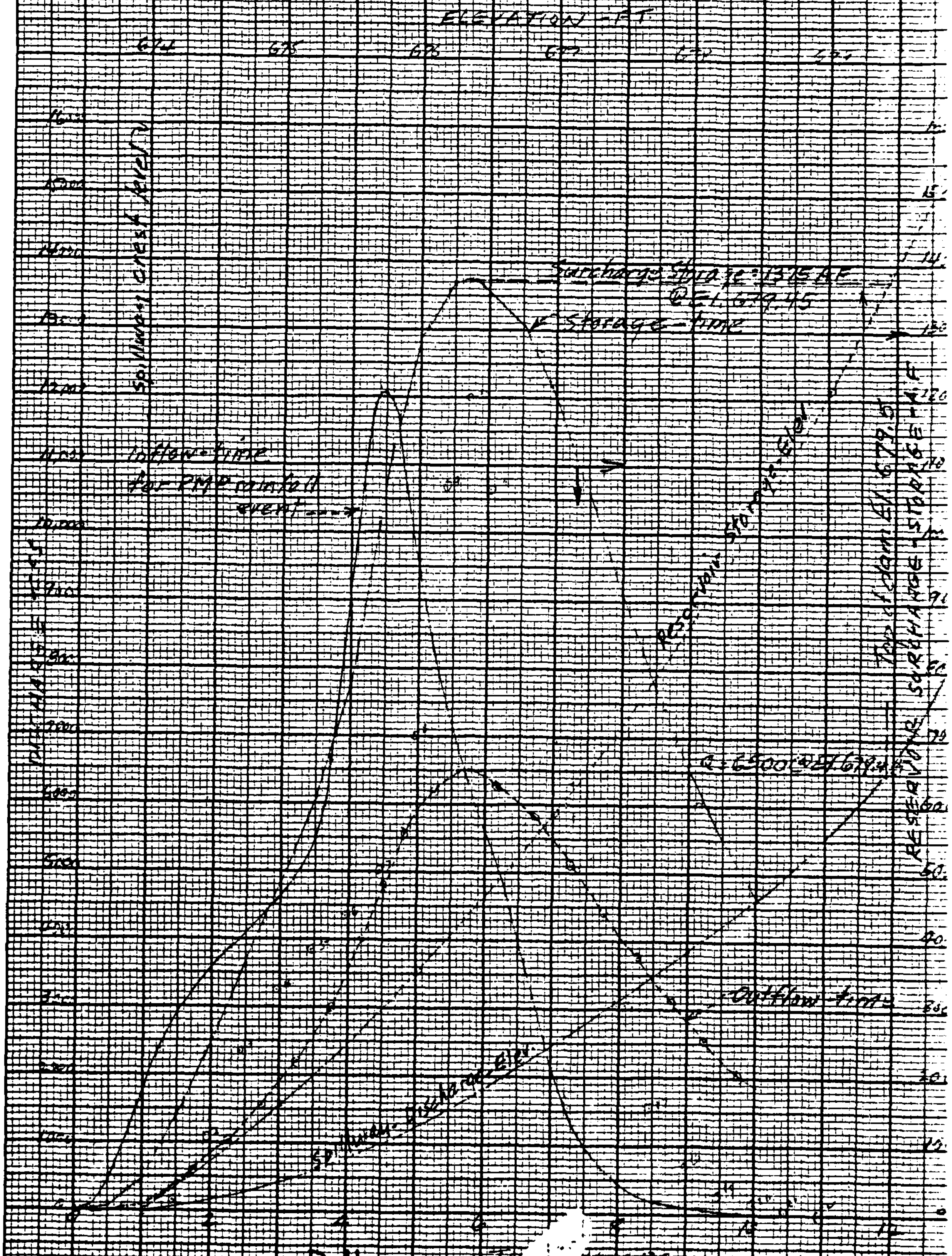


PLATE 8

UPPER BOLTON LAKE RESERVOIR

FLOOD ROUTING FOR 1/2 PMF EVENT

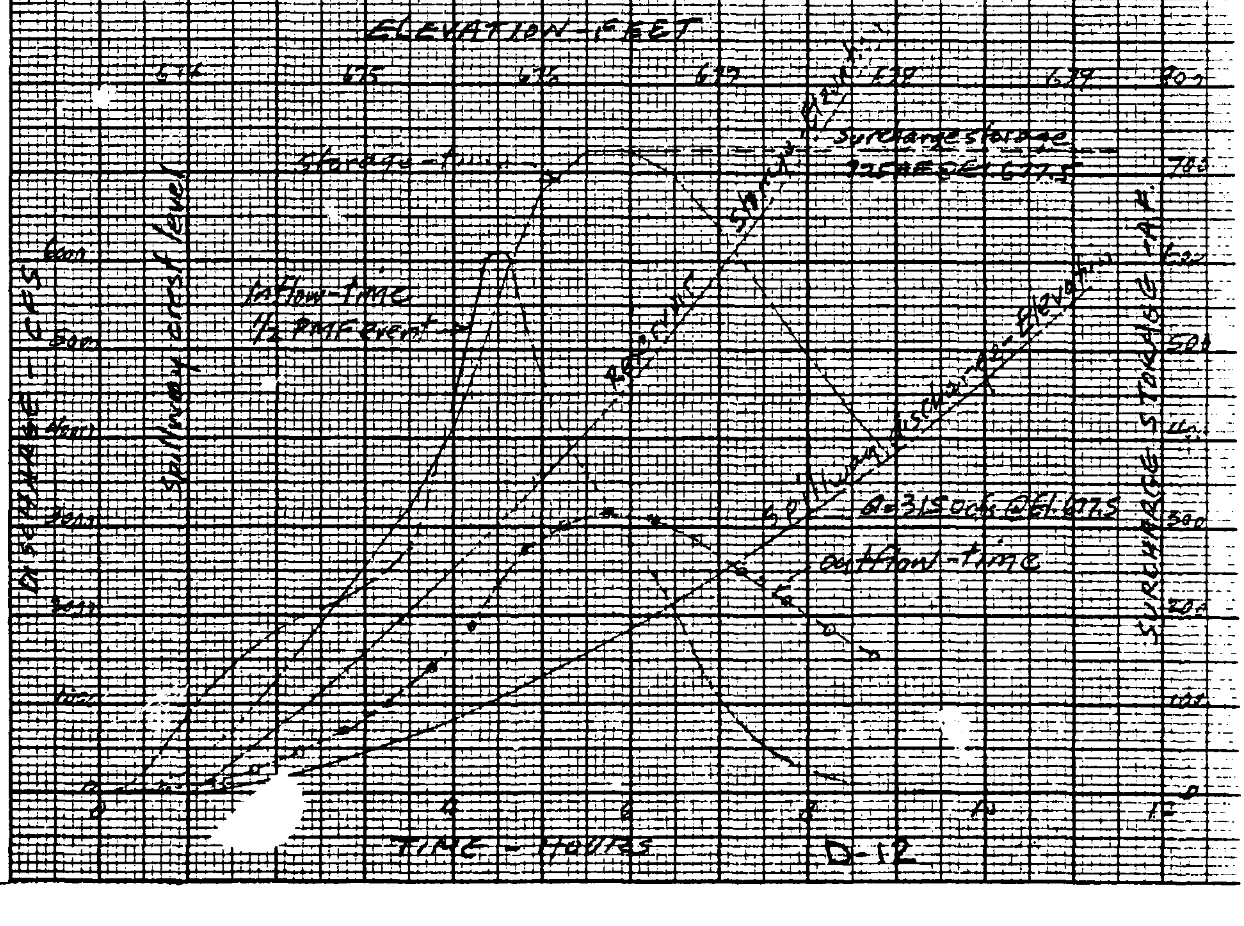


PLATE 9

LOWER ... LAKE RESERVOIR

INFLOW HYDROGRAPHS FOR PMF and 1/2 PMF EVENTS

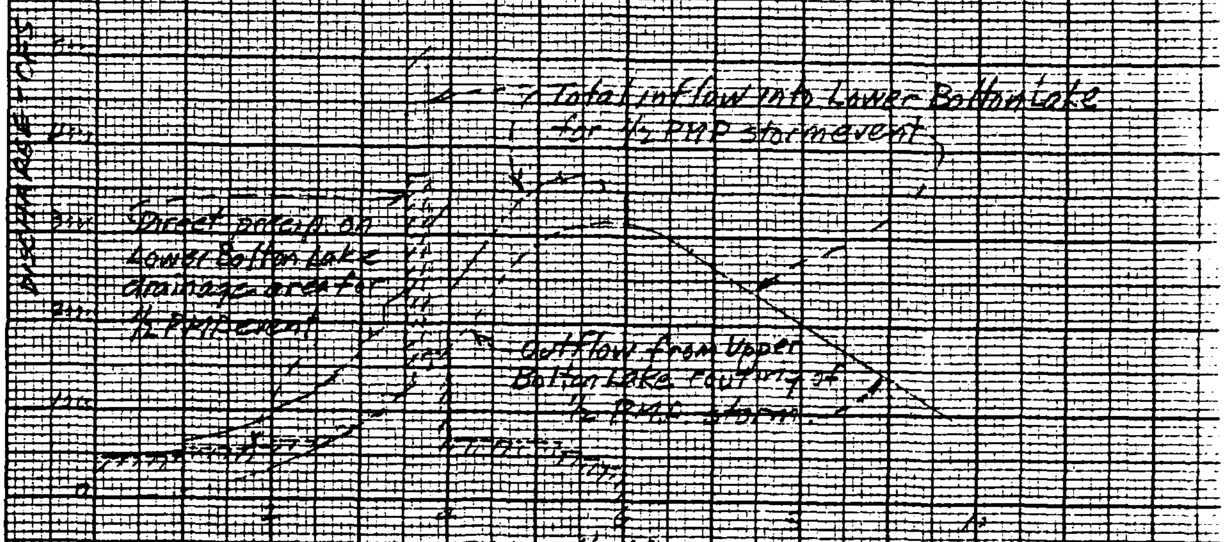


Fig 7(A)

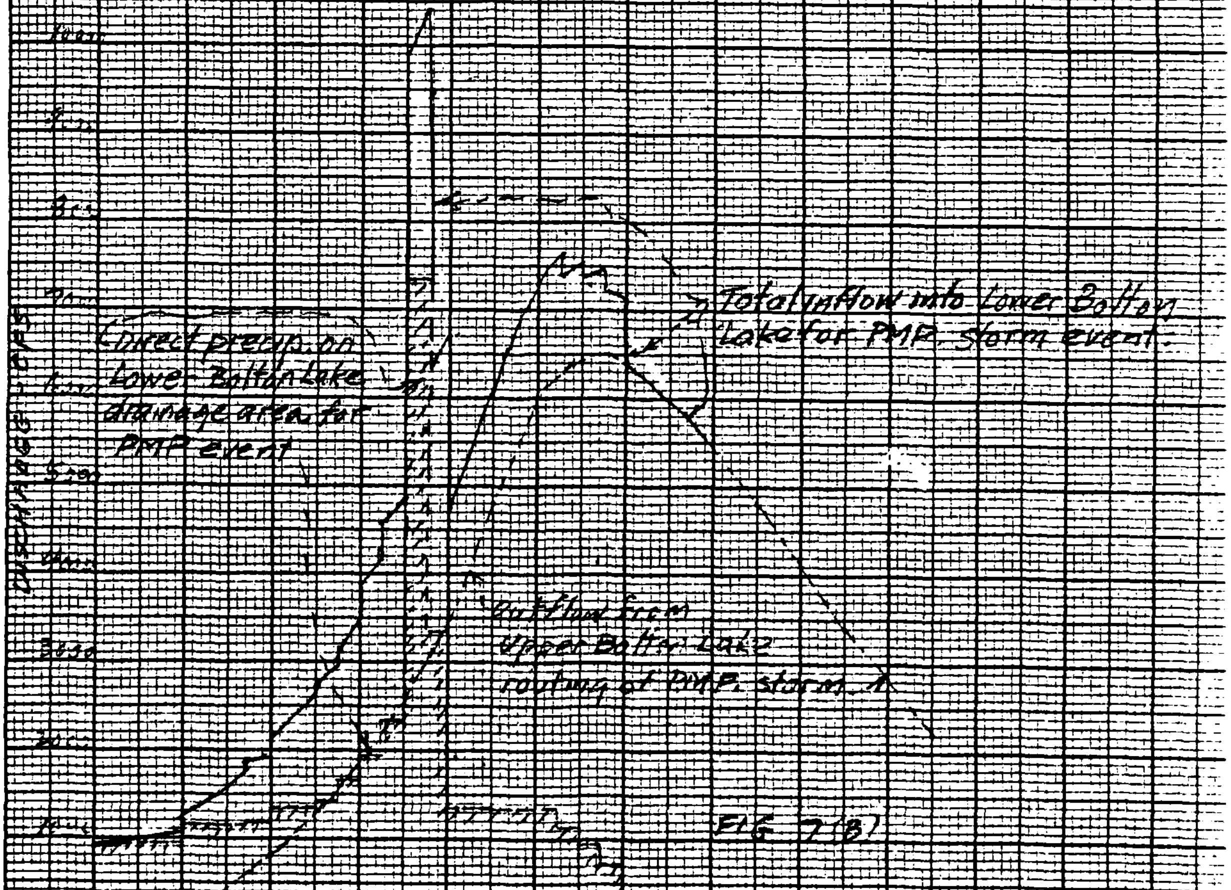


FIG 7(B)

BY [illegible] DATE 12-14-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ INSPECTION OF DAMS - CONN. & RI. PROJECT ____

SUBJECT UPPER AND LOWER BOLTON LAKE RESERVOIRS

FLOOD INFLOWS BETWEEN UPPER AND LOWER BOLTON LAKE DAM

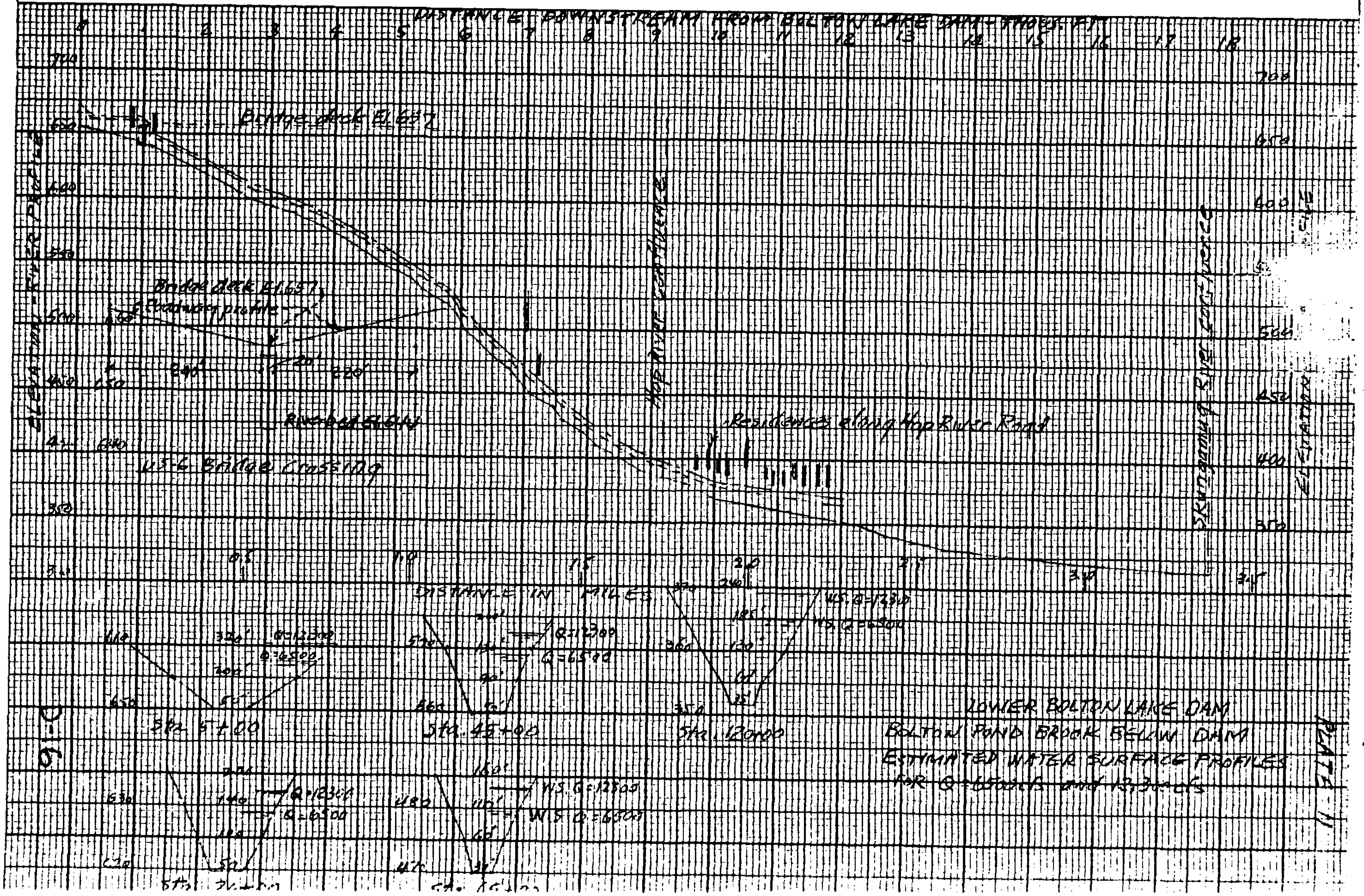
Drainage area 0.8 sq. mi 1"/hr = 645.33 cfs/sq. mi.

On 0.8 sq mi, for 15 minute intervals Inflow = 645.33 × 4 × 0.8 = 2065 cfs/in.

Time hrs	Excess Precip distrib for 24-hr Storm × 0.8	Inflows cfs for PMP flood	Inflows cfs for 1/2 PMP flood
0.25	0.45	929	465
0.50	0.45	929	465
0.75	0.46	950	475
1.00	0.46	950	475
1.25	0.55	1136	566
1.50	0.55	1136	568
1.75	0.55	1136	568
2.00	0.56	1156	578
2.25	0.65	1342	671
2.50	0.65	1342	671
2.75	0.68	1404	702
3.00	0.81	1673	837
3.25	0.94	1941	970
3.50	1.13	2333	1167
3.75	3.56	7351	3676
4.00	1.62	3345	1672
4.25	0.65	1342	671
4.50	0.65	1342	671
4.75	0.65	1342	671
5.00	0.65	1342	671
5.25	0.65	1342	671
5.50	0.55	1136	568
5.75	0.46	950	475
6.00	0.35	723	361
	18.68	38572 cfs/15 min	

$$= \frac{38572 \times 60 \times 15}{43560}$$

= 797 AF 400 AF



DISTANCE DOWNSTREAM FROM BOLTON LAKE DAM - THOUS. FT
ELEVATION - RIVER PROFILE
ELEVATION
Bridge deck El 627
Bridge deck El 657
Estimated profile
Riverbed El 641
U.S. 6 Bridge Crossing
Hop River Confluence
Residences along Hop River Road
Skungamaug River Confluence
DISTANCE IN MILES
Sta. 5+00
Sta. 45+00
Sta. 120+00
Q=12300
Q=6500
W.S. Q=12300
W.S. Q=6500
LOWER BOLTON LAKE DAM
BOLTON POND BROOK BELOW DAM
ESTIMATED WATER SURFACE PROFILES
FOR Q=6500 cfs and 12300 cfs
PLATE 11
D-16

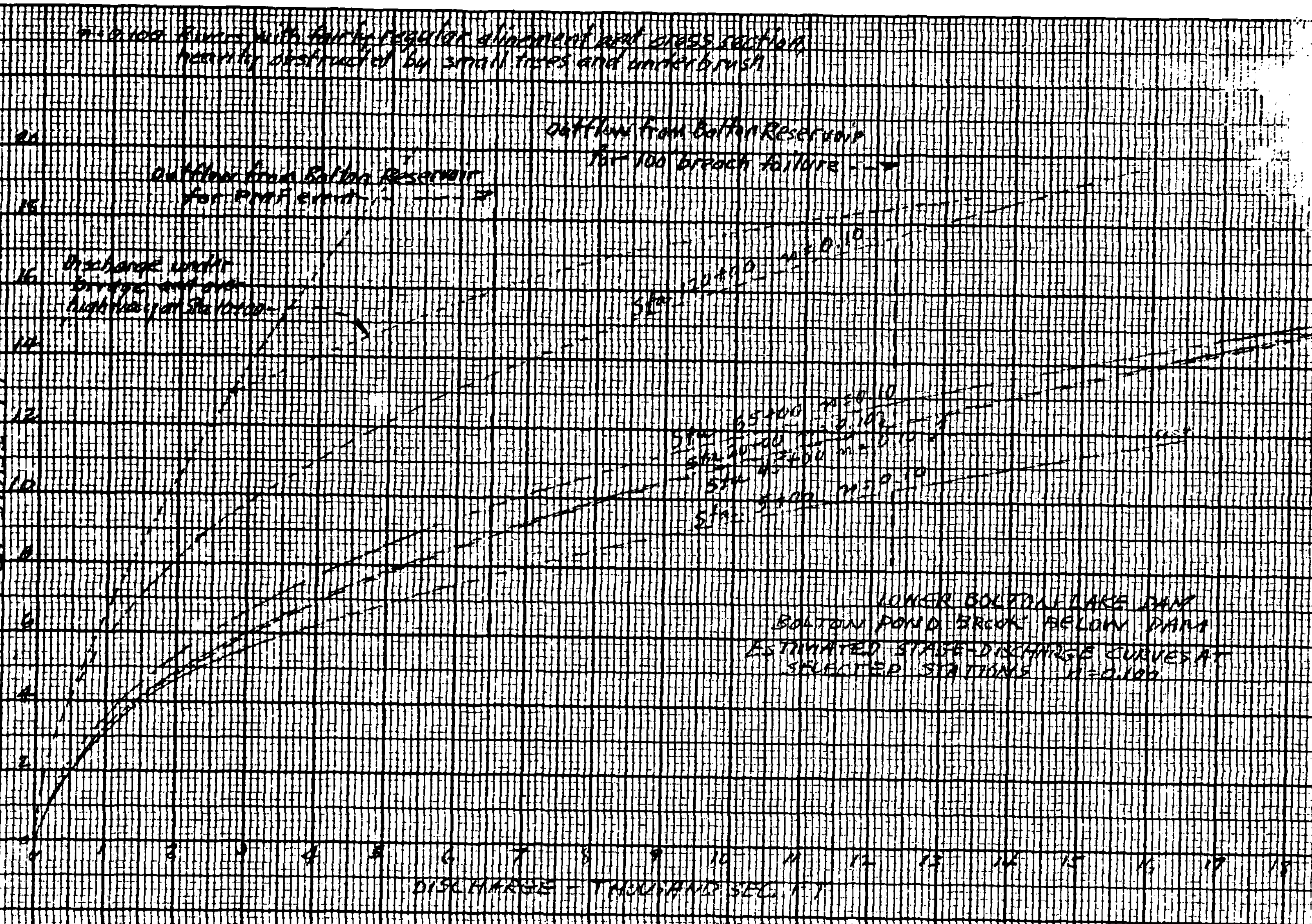

n=0.100 Run with fairly regular alignment and cross section heavily obstructed by small trees and underbrush
Outflow from Bolton Reservoir for 100' breach failure
Outflow from Bolton Reservoir for PMF event
Discharge under bridge and over highway at Sta 10+00
Sta 10+00 n=0.10
Sta 65+00 n=0.10
Sta 60+00
Sta 42+00 n=0.10
Sta 5+00 n=0.10
LOWER BOLTON LAKE DAM
BOLTON POND BROOK BELOW DAM
ESTIMATED STAGE-DISCHARGE CURVES AT SELECTED STATIONS n=0.100
RIVER STAGE - FT
DISCHARGE - THOUSAND SEC. FT
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
2
4
6
8
10
12
14
16
18
20

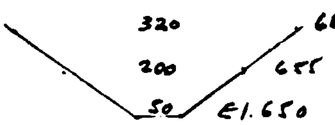
PLATE 12

BY______ DATE______ LOUI[illegible] [illegible]GER & ASSOCIATES INC. SHEET NO.______ OF

CHKD. BY______ DATE______ PROJECT______

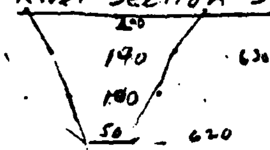
SUBJECT BOLTON LAKE DAM - RIVER STAGE BELOW DAM

River Section Sta 5+00   s = 0.014   n = 0.10



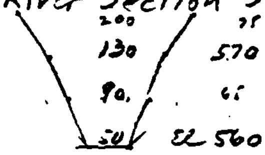
El	Depth	Width	Average width	Δ Area	Σ Area	WP	r	$r^{2/3}$	K $=14.86 r^{2/3} A$	Q = KS
650	0	50								0
655	5	200	125	625	625	200.5	3.12	2.13	19819	234
660	10	320	260	1300	1925	320.7	6.00	3.30	94485	11,18

River Section Sta 20+00   s = 0.025   n = 0.10



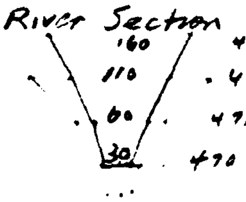
El	Depth	Width	Average width	Δ Area	Σ Area	WP	r	$r^{2/3}$	K	Q
620	0	50			0					
625	5	100	75	375	375	101.0	3.71	2.40	13362	2113
630	10	140	120	600	975	142.2	6.86	3.61	52294	8268
635	15	200	170	850	1825	203.0	8.99	4.32	117251	18539

River Section Sta 45+00   s = 0.030   n = 0.10



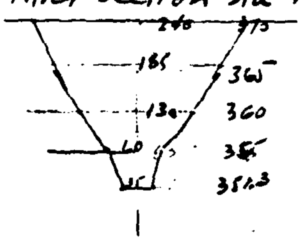
El	Depth	Width	Ave width	Δ area	Σ area	WP	r	$r^{2/3}$	k	Q
560	0	50			0					0
565	5	90	70	350	350	91.2	3.84	2.45	12746	2,207
570	10	130	110	550	900	132.4	6.80	3.59	47987	8,312
575	15	200	165	825	1725	203.1	8.49	4.16	106711	18,48

River Section Sta 65+00   s = 0.050   n = 0.10



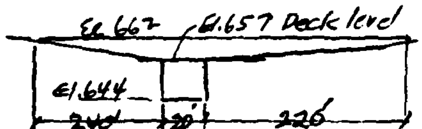
El	Depth	Width	Ave width	Δ area	Σ Area	W.P.	r	$r^{2/3}$	K	Q
470	0	30			0					0
475	5	60	45	225	225	61.6	3.65	2.37	7928	1772
480	10	110	85	425	650	112.6	5.77	3.22	31086	6951
485	15	160	135	675	1325	163.6	8.10	4.03	79415	17758

River Section Sta 120+00   s = 0.0065   n = 0.010



El	Depth	Width	Ave width	Δ area	Σ area	W.P.	r	$r^{2/3}$	K	Q
351.3	0	35			0					
355	3.7	60	47.5	176	176	61.1	2.88	2.03	5297	427
360	8.7	130	95	475	651	131.8	4.94	2.90	28057	2262
365	13.7	185	157.5	788	1439	187.7	7.67	3.89	83145	6703
370	18.7	240	212.5	1063	2502	243.6	10.27	4.73	175689	14164

Flow at Bridge (U.S. 6) crossing @ Sta 10+00



Thru bridge $Q = CLH^{3/2}$ C = 3.0

WS El.	H	Thru Bridge ΔQ	Over Road C = 2.4 H	gH^{t}	Av. gH^{t}	L	ΔQ	ΣQ
644	0	0						0
650	6	880						880
654	10	1900						1900
657	13	2800	0					2800
659	15	3485	2	6.79	3.40	184	625	4110
662	18	4580	5	26.83	13.42	460	70	10750
664	20	5360	7	44.45	22.23	644	00	19660

BY 76 DATE ..14

LOUIS BERGER & ASSOCIATES INC.

CHKD. BY ______ DATE ______ Belton Lake (Lower) SHEET NO. ______ OF ______

SUBJECT Precipitation Data PROJECT W-189

Drainage Area = 0.71 sq. mi.
24 hr, 200 sq. mi. PMP ≟ 21.5 inches
6 hr, < 10 sq. mi. PMP = 24.3 inches
20 % reduction for basin fit = 19.4 inches

Time	%	Precip.	Δ	Rea. Δ	Infil loss	Runoff	Qp/in.
.25	18.5	3.59	3.59	.48	0.03	.45	979
.5	27	5.24	1.65	.48	↓	.45	979
.75	33	6.40	1.16	.49	↓	.46	1000
1	38	7.37	.97	.49	↓	.46	1000
1.25	42.3	8.21	.84	.58	↓	.55	1196
1.5	46	8.92	.71	.58	↓	.55	1196
1.75	49.5	9.60	.68	.58	↓	.55	1196
2	53	10.28	.68	.59	↓	.56	1196
2.25	56.5	10.96	.68	.68	↓	.65	1414
2.5	60	11.64	.68	.68	↓	.65	1414
2.75	63.5	12.32	.68	.71	↓	.68	1479
3	67	13.	.68	.84	↓	.81	1762
3.25	70	13.58	.58	.97	↓	.94	2044
3.5	73	14.16	.58	1.16	↓	1.13	2458
3.75	76	14.74	.58	3.59	↓	3.56	7743
4	79	15.33	.59	1.65	↓	1.62	3523
4.25	82.5	16.01	.68	.68	↓	.65	1414
4.5	84.5	16.39	.38	.68	↓	.65	1414
4.75	87	16.88	.49	.68	↓	.65	1414
5	90	17.46	.58	.68	↓	.65	1414
5.25	92.5	17.95	.49	.68	↓	.65	1414
5.5	95	18.43	.48	.58	↓	.55	1196
5.75	92.5	18.92	.49	.49	↓	.46	1000
6	100	19.4	.48	.38	↓	.35	761

Tc determined by overland flow: L = 600 ft, H = 50 ft.
∴ slp = 8% & avg vel. = 3 fps per Texas H.D.

$$T_c = \frac{600}{3 \times 3600} = .06 \text{ hrs} \qquad Lag = .033 \text{ hrs}$$

$$T_p = Lag + D/2 = .158 \text{ hrs} \quad . \quad Q_p = 484 \, \underline{(A) Q} - 2175 \text{ cfs}$$

BY. K DATE 9/82 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO.______ OF______

CHKD. BY______ DATE______ Bolton Lake (Lower) #6 PROJECT W-189

SUBJECT Surcharge Storage Capacity

Planimetered Areas - Elev. datum = MSL

Lake at El. 667 - 176 Ac. Lakes at El. 674 - 360 Ac.

Contour El. 670 - 204 Ac.

Contour El. 680 - 580 Ac.

El.	Area	Sur. Stor. Cap.	
670	14 Ac + 176 Ac + 14 Ac	570	Ac Ft
669	9.3 Ac	371	"
668	4.7 Ac	181	"
667	176 Ac	0	"

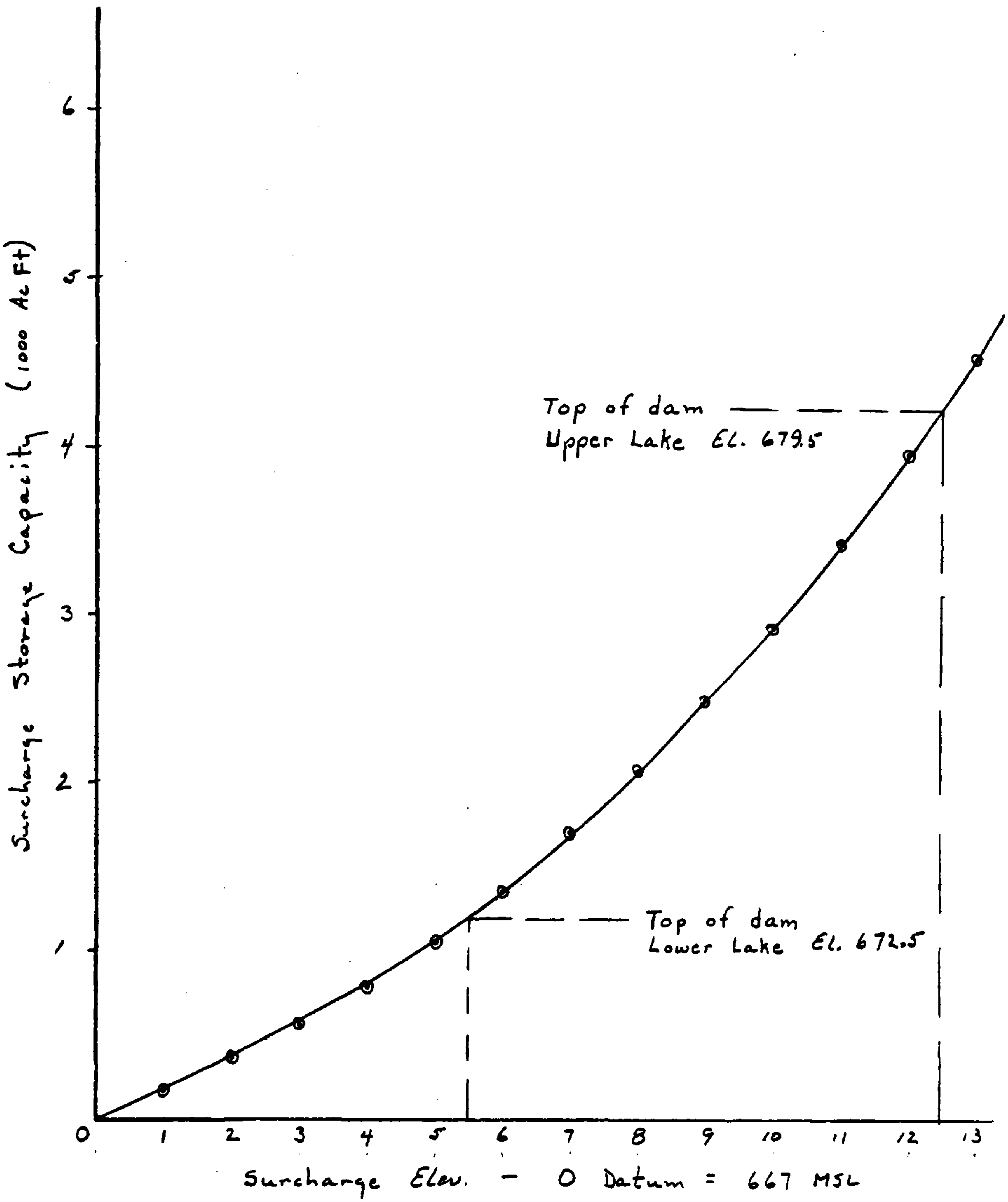
El.	Area	Sur. Stor. Cap.	
674	78 Ac + 204 Ac + 78 Ac	1698	Ac. Ft.
673	58.5 Ac	1358	"
672	39 Ac	1056	"
671	19.5 Ac	794	"
670	204 Ac	570	"

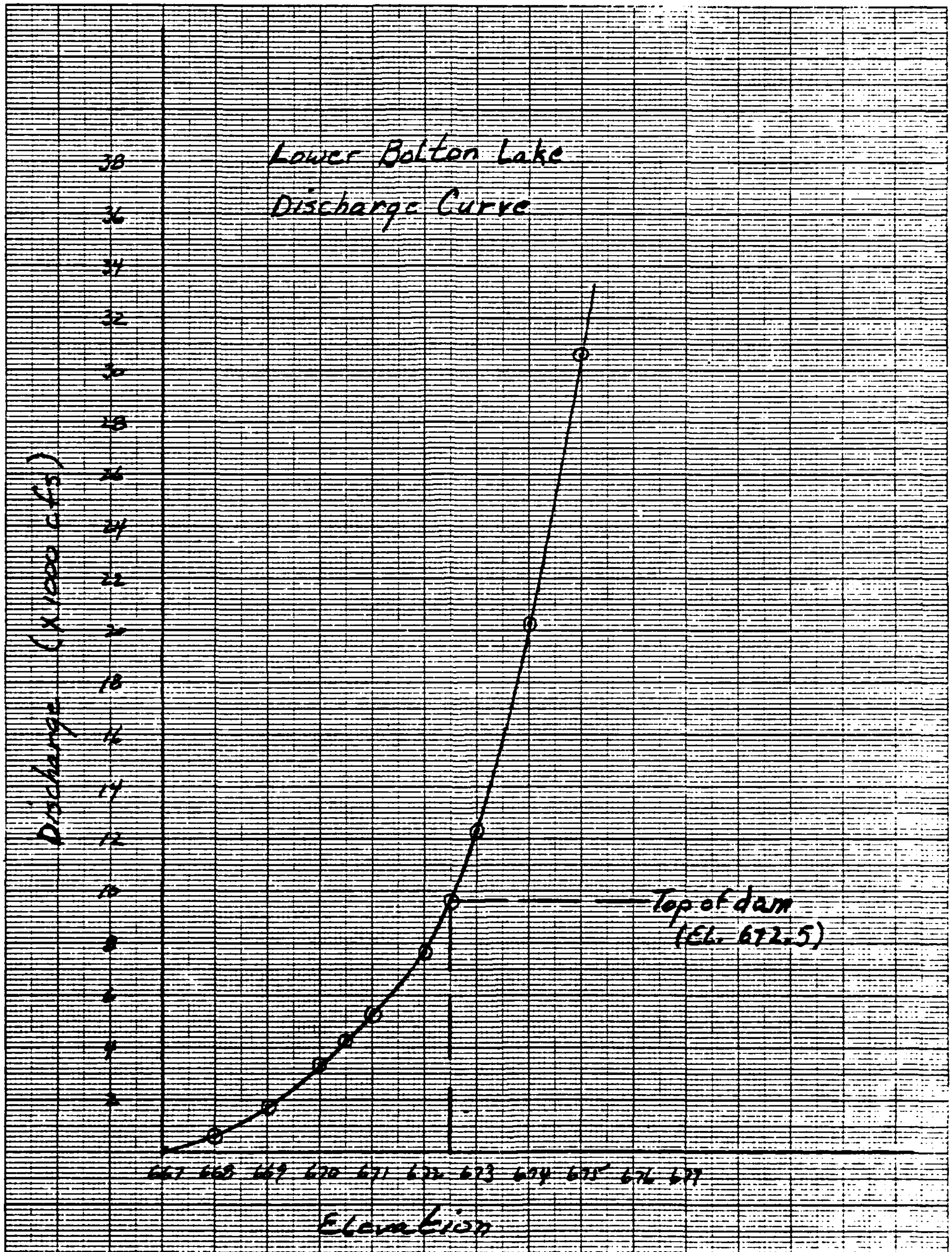
El.	Area	Sur. Stor. Cap.	
680	110 Ac + 360 Ac + 110 Ac	4518	Ac. Ft.
679	91.7 Ac	3957	"
678	73.3 Ac	3431	"
677	55 Ac	2943	"
676	36.7 Ac	2491	"
675	18.3 Ac	2076	"
674	360 Ac	1698	"

BY: ½ DATE: 9/22 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ BOLTON LAKE (LOWER) PROJECT: W-189

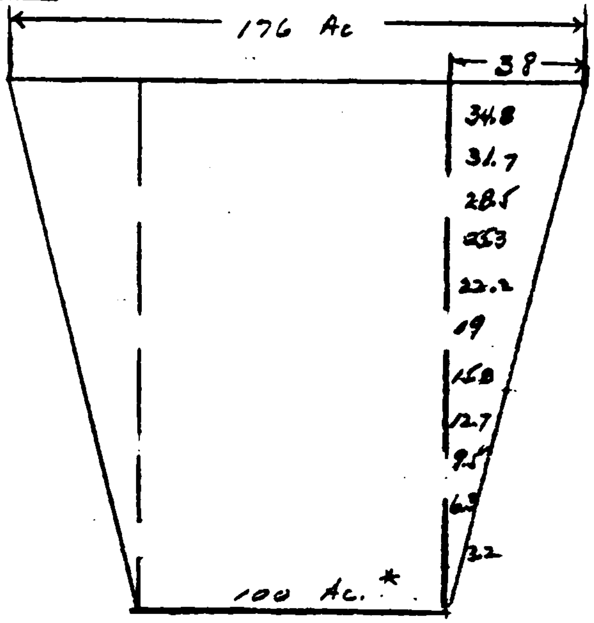
SUBJECT: Surcharge Storage Curve





Lower Bolton Lake
Discharge Curve
Discharge (X1000 cfs)
Top of dam
(EL. 672.5)
Elevation

BY: ___ DATE: 10/11-73 ASSOCIATES INC. SHEET NO. ___ OF ___
CHKD. BY ___ DATE ___ Lake PROJECT: W-189
SUBJECT: Estimated Storage To Elev. 667 + D.D. Time



Drawdown Time Incre. days		Storage Cum.		Storage Incre.
	38	1656	Ac Ft	--
4.2	34.8	1483	"	173
4.3	31.7	1317	"	166
4.5	28.5	1157	"	160
4.6	25.3	1002	"	155
4.8	22.2	855	"	147
5.6	19	714	"	141
6.1	15.8	579	"	135
7.7	12.7	451	"	128
10.4	9.5	329	"	122
	6.3	213	"	116
	3.2	103	"	110
				103

* Planimetered extrapolated contours.

Lake capacity approx. 1650 Ac Ft.

LOUIS BERGER & ASSOCIATES INC.

BY ____ DATE 10/13

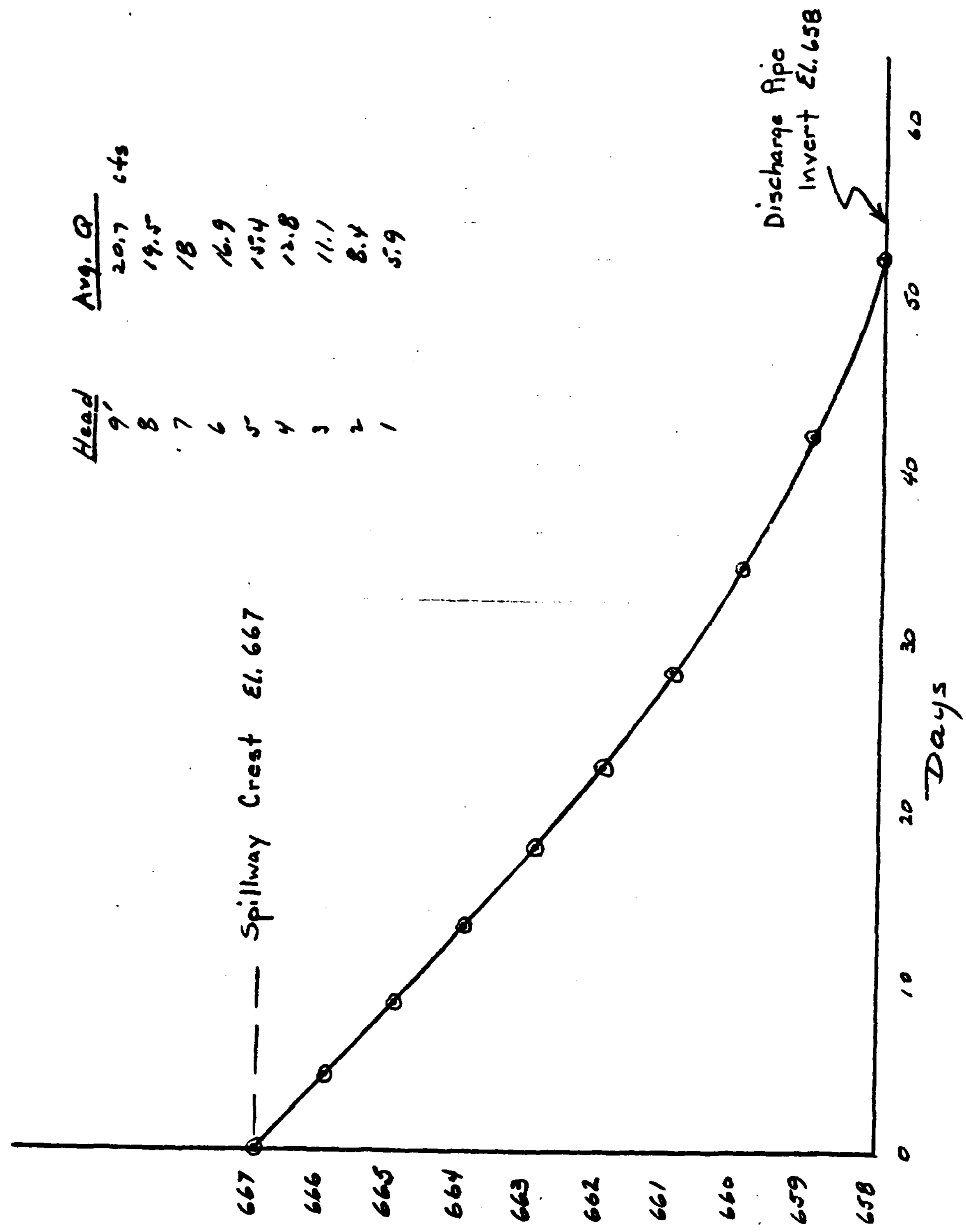
CHKD. BY ____ DATE ____

SUBJECT Bolton Lake — Drawdown Curve - 15" ⌀ Drain

SHEET NO. ____ OF ____

PROJECT W-179

Head	Avg. Q
9'	20.7 cfs
8	19.5
7	18
6	16.9
5	15.4
4	13.8
3	11.1
2	8.4
1	5.9



BY Ko DATE 12/4 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ Bolton Lake (upper) #6 PROJECT W-179

SUBJECT Precipitation Data

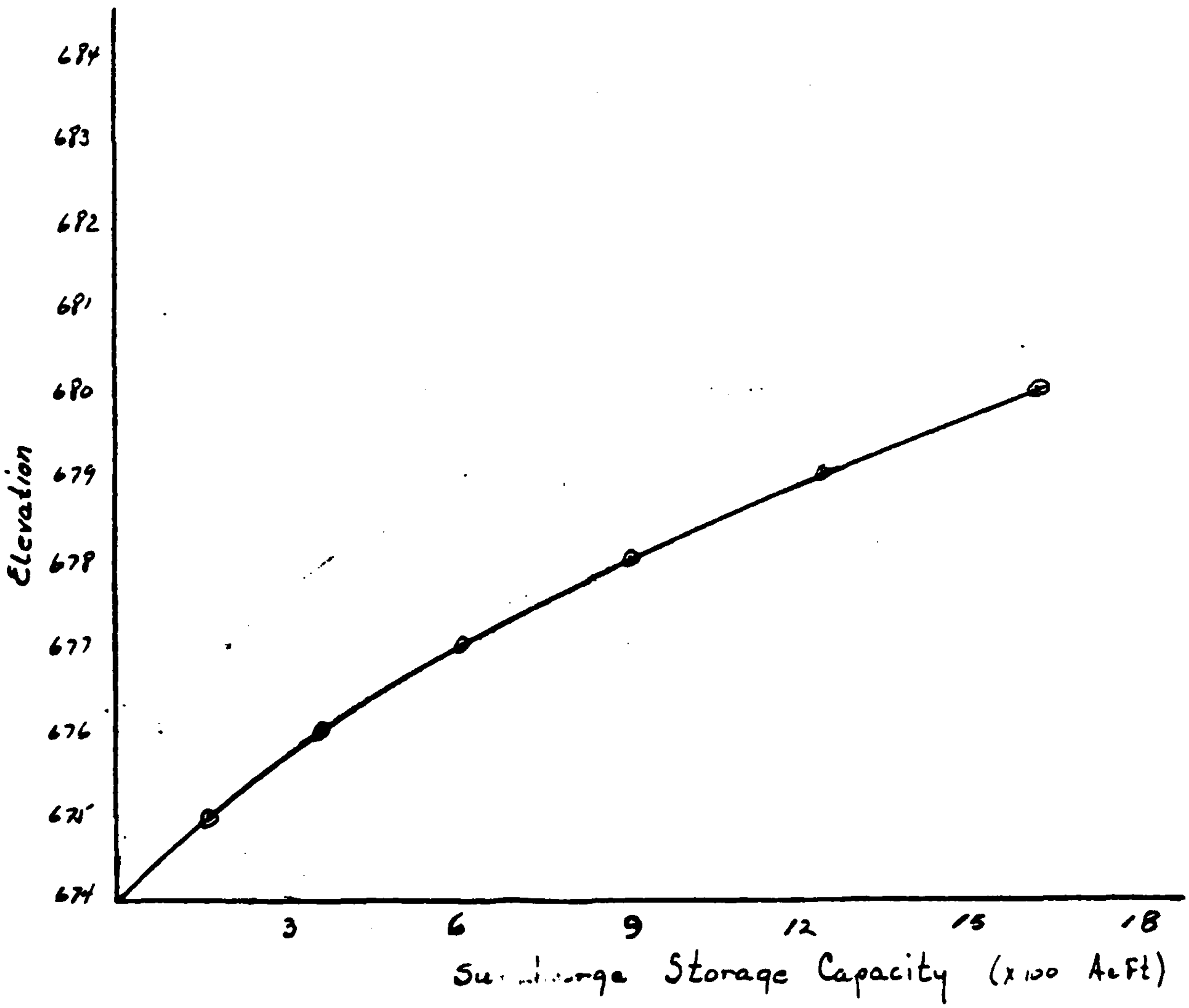
Drainage Area - 3.07 sq. mi.
24 hr, 200 sq. mi. PMP - 21.5 inches
6 hr, < 10 sq. mi. PMP - 24.3 inches
20% reduction for basin fit = 19.4 inches

Time	%	Precip.	Δ	Rea. Δ	Infil. Loss	Runoff
.25	18.5	3.59	3.59	.48	0.03	.45
.5	27	5.24	1.65	.48		.45
.75	33	6.40	1.16	.49		.46
1	38	7.37	.97	.49		.46
.25	42.3	8.21	.84	.58		.55
.5	46	8.92	.71	.58		.55
.75	49.5	9.60	.68	.58		.55
2	53	10.28	.68	.59		.56
.25	56.5	10.96	.68	.68		.65
.5	60	11.64	.68	.68		.65
.75	63.5	12.32	.68	.71		.68
3	67	13.0	.68	.84		.81
.25	70	13.58	.58	.97		.94
.5	73	14.16	.58	1.16		1.13
.75	76	14.74	.58	3.59		3.56
4	79	15.33	.59	1.65		1.62
.25	82.5	16.01	.68	.68		.65
.5	84.5	16.39	.38	.68		.65
.75	87	16.88	.49	.68		.65
5	90	17.46	.58	.68		.65
.25	92.5	17.95	.49	.68		.65
.5	95	18.43	.48	.58		.55
.75	97.5	18.92	.49	.49		.46
6	100	19.4	.48	.38		.35

BY _JK_ DATE _10-3_ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____
CHKD. BY. ____ DATE ____ Bolton Lake (Upper) PROJECT ____
SUBJECT Surcharge Storage Capacity

Planimetered Areas - Elev. datum = MSL
Lake at El. 674 - 136 Acres
Contour El. 680 - 406 Ac.

El.	Area	Avg. Area		Incre. Stor.		Cum. Stor.	
680	406	384	Ac	384	AcFt	1629	AcFt
679	361	339	"	339	"	1245	"
678	316	294	"	294	"	906	"
677	271	249	"	249	"	612	"
676	226	204	"	204	"	363	"
675	181	159	"	159	"	159	"
674	136				"		"



BY TC DATE 10/2 LOUIS BERGER & ASSOCIATES INC. SHEET NO.____ OF____

CHKD. BY____ DATE____ BOLTON LAKE (UPPER) PROJECT W-189

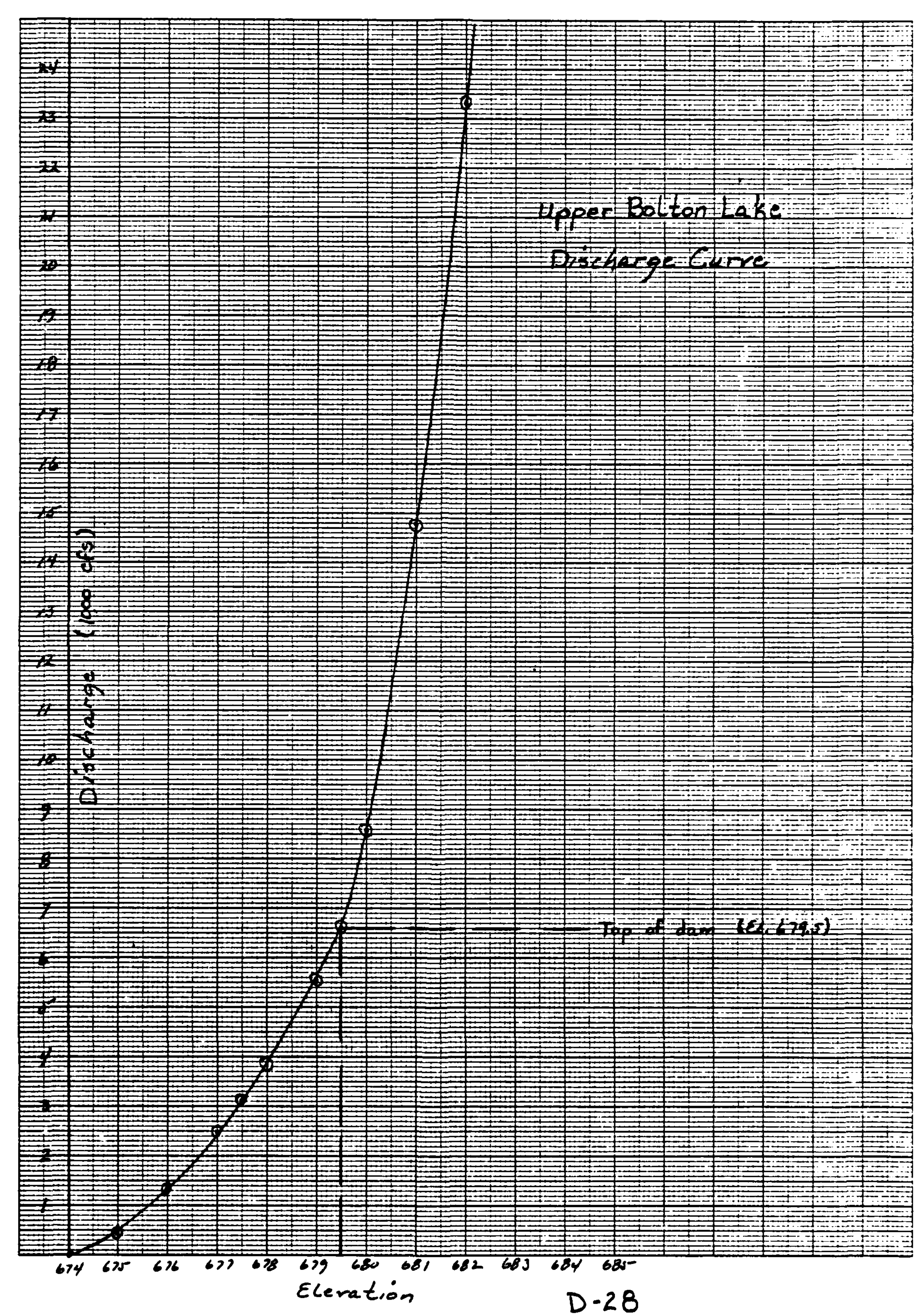
SUBJECT Lag Time & Dimensionless Unitgraph

Tc = 1.66 hours Lag = 0.6 Tc = 0.966 hours

Unit time = .25 hr. — Lag + D/2 = 1.09 hr. — Area: 3.07 mi^2

DSF = 26.89 x Area = 82.55

Hours	T/Tp	Ord.	Q in cfs
.25	.229	.0997	136
.5	.459	.3685	502
.75	.688	.7496	1021
1	.917	.9751	1329
.25	1.147	.9518	1297
.5	1.376	.7806	1064
.75	1.606	.5558	758
2	1.835	.4025	549
.25	2.064	.2944	401
.5	2.294	.2118	289
.75	2.523	.1493	204
3	2.752	.1057	144
.25	2.982	.0771	105
.5	3.211	.0593	81
.75	3.440	.0407	55
4	3.670	.0299	41
.25	3.899	.0216	29
.50	4.128	.0157	21
.75	4.358	.0115	16


Upper Bolton Lake
Discharge Curve
Discharge (1000 cfs)
Top of dam (El. 679.5)
Elevation
674
675
676
677
678
679
680
681
682
683
684
685

9-218

File 12-1-1

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Hourly precipitation, in inches, at Shenipsit Lake, Rockville, Conn. for June, 1944

Rain gage type .... Altitude .... feet above m. s. l. Location ....

Date	A.M. 1	2	3	4	5	6	7	8	9	10	11	12	P.M. 1	2	3	4	5	6	7	8	9	10	11	12	Sum
1																									
2																									
3																									
4																									
5																									
6																									
7	.08																								.08
8																									
9																									
10									.05	.03	.12	.06	.06	.01	.01	.01		.03	.12	.10					.60
11																									
12																									
13																									
14																									
15			.01	.02			.03																		.06
16																			.32	.01	.02				.35
17																									
18																									
19																	.08	.03		.02	.17				.30
20		.03						.01	.01			.15	.14	.05			.01	.01	.01						.42
21					.10					.01	.01					.01	.01		.01	.01	.01				.17
22																									
23																									
24						.20	.10	.02	.13	.85	.60	1.05	.75	.60	1.02	.09							.03	.01	5.45
25																									
26																									
27																									
28																									
29																									
30																									
31	(Records furnished by Rockville Water & Aqueduct Company)																		(See over)						

* Snow. : Mixed rain and snow. # Hail or sleet. T Trace.

Time standard used Eastern

U. S. GOVERNMENT PRINTING OFFICE 16—11012

~~Total for month~~ Received 6/29/44

D-29

Other rainfall records, storm of June 24, 1944

Manchester (Porter Reservoir)	3.14"	(Furnished by Manchester Water Company)
Storrs (Conn. State College)	2.69"	(Furnished by Connecticut State University)
Mansfield (Lee Farm, Storrs College)	3.84"	

Other runoff determination, storm of June 24, 1944

Tankerhoosen River near Vernon, Conn.	60	sec.-ft./sq.mi.
Skungamaug River near Tolland, Conn.	7.5	sec.-ft./ sq.mi.

D-30

12-1-1

UNITED STATES
DEPARTMENT OF THE INTERIOR

Water Resources Branch

GEOLOGICAL SURVEY

203 Federal Building
P. O. Box 715,
Hartford 1, Conn.

July 18, 1944.

RECEIVED
JUL 18 1944
STATE WATER COMMISSION

General S. H. Wadhams, Director,
Connecticut State Water Commission,
State Office Building,
Hartford, Conn.

Dear General Wadhams:

In accordance with Mr. Martin's recent telephone request, we are submitting herewith blueprints of hydrographs and other data relating to the rainfall, runoff and storage effect at Willimantic Reservoir (Bolton Lakes), during the storm of June 24, 1944.

We have previously discussed and explained this information to Messrs. Martin and Wise, pointing out that several estimates or assumptions had to be made in determining the hydrographs as shown, and the indicated results should, therefore, be considered as approximate only.

Sheet No. 1 illustrates the runoff events as they possibly actually occurred at the Lakes. The hydrograph of inflow into the upper reservoir is based on a hydrograph of inflow into Shenipsit Lake for the same storm, which was determined from gage readings and reservoir storage data furnished by the Rockville Water & Aqueduct Co. The peak flows over the upper and lower dams respectively, were computed from information obtained by field surveys at the dams. It was assumed that both reservoirs at the start of the storm, were at the levels of the lowest points in the respective dam crests.

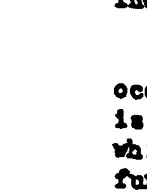
Sheet No. 2 shows a similar approximate picture of what would have happened during this same storm if both reservoirs had been at a level 12 inches below the lowest points in the respective dam crests. The results appear to indicate that 12 inches of available storage would have reduced the peak flow at the lower dam for this particular storm, by approximately one-third (from 225 sec.-ft. to 140 sec.-ft.).

Very truly yours,

Lower Reservoir .27 sq mi 173 acres
Upper Reservoir .22 sq mi 147

B. L. Bigwood

B. L. BIGWOOD,
District Engineer.



BLB/EKF

D-31

FINAL BOLTON 10-[illegible]

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*****************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
*****************************
                    BOLTON LAKE DAM INSPECTION
                    BY D.J.MULLIGAN
                    OCT 78

                                        JOB SPECIFICATION
                        NO   NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
                       100     0    15     0     0     0     0     0     0     0
                                          JOPER   NWT
                                              3     0

        **********      **********      **********      **********      **********

                                   SUB-AREA RUNOFF COMPUTATION

                   INFLOW HYDROGRAPH
                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                            6       0       0       0       2       0       1
                                      HYDROGRAPH DATA
                  IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                     -1       0    0.70     0.0    0.70     0.0     0.0       0       0       0

                                      INPUT HYDROGRAPH
            1040.      1434.      1460.      1510.      1808.      1939.      2106.      2316.      2714.      2942.
            3241.      3762.      4289.      4959.     10539.      6702.      5107.      5759.      6423.      6986.
            7584.      7698.      7647.      7420.      6564.      6366.      6067.      5676.      5330.      4991.
            4633.      4271.      3918.      3596.      3293.      3009.      2745.      2501.      2277.      2071.
     [illegible]       1711. [illegible] [illegible] [illegible]     1176.      1077.       988. [illegible] [illegible]
             757.       693.       635.       581.       532.       487.       446.       409.       374.       343.
             314.       287.       263.       241.       221.       202.       185.       169.       155.       142.
             130.       119.       109.       100.        91.        84.        77.        70.        64.        59.
              54.        49.        45.        41.        38.        35.        32.        29.        27.        24.
              22.        20.        19.        17.        16.        14.        13.        12.        11.        10.

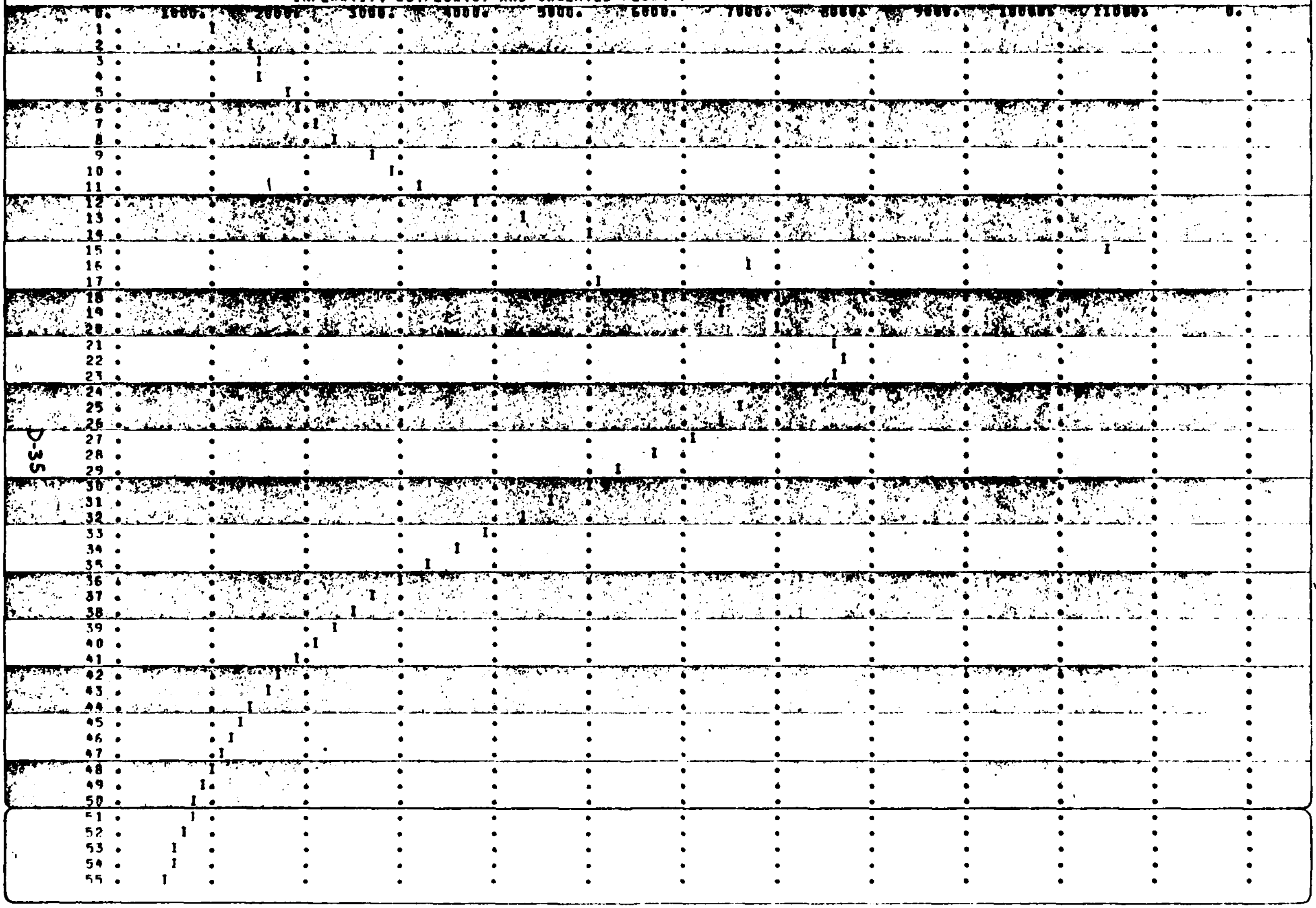
                            PEAK   6-HOUR  24-HOUR  72-HOUR  TOTAL VOLUME
                   CFS    10539.    5816.    2045.    1964.      196366.
                INCHES              77.29   108.70   108.73       108.73
                 AC-FT              2885.    4058.    4059.        4059.
```

D-34

60VR.

STATION 8

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)



D-35

ROUN.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

FLOOD ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
66	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0.

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	0.	181.	371.	570.	794.	1056.	1358.	1698.	2076.	0.
OUTFLOW=	0.	612.	1775.	3341.	5315.	7651.	12319.	20254.	30588.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	251.	1040.	1040.
2	255.	1237.	1063.
3	262.	1447.	1109.
4	270.	1485.	1154.
5	279.	1656.	1214.
6	292.	1871.	1292.
7	306.	2023.	1379.
8	322.	2211.	1478.
9	343.	2515.	1601.
10	366.	2828.	1747.
11	392.	3092.	1942.
12	422.	3502.	2176.
13	457.	4026.	2454.
14	499.	4624.	2781.
15	594.	7749.	3548.
16	698.	8621.	4395.
17	718.	5905.	4647.
18	733.	5433.	4778.
19	758.	6091.	4997.
20	790.	6705.	5282.
21	828.	7285.	5619.
22	866.	7641.	5960.
23	899.	7673.	6249.
24	923.	7534.	6466.
25	933.	6992.	6555.
26	931.	6465.	6539.
27	925.	6217.	6485.
28	914.	5872.	6382.
29	897.	5503.	6233.
30	877.	5161.	6052.
31	853.	4812.	5843.
32	827.	4452.	5608.
33	798.	4095.	5353.
34	768.	3757.	5086.
35	737.	3445.	4812.
36	706.	3151.	4535.
37	674.	2877.	4258.
38	643.	2623.	3985.
39	613.	2389.	3719.

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40	584.	2174.	3462.
41	555.	1977.	3226.
42	528.	1797.	3011.
43	502.	1633.	2804.
44	477.	1483.	2605.
45	452.	1348.	2416.
46	430.	1230.	2238.
47	409.	1127.	2071.
48	389.	1032.	1914.
49	370.	945.	1770.
50	353.	865.	1662.
51	336.	792.	1539.
52	319.	725.	1460.
53	304.	664.	1365.
54	289.	608.	1275.
55	275.	557.	1189.
56	262.	510.	1109.
57	[illegible]	467.	1032.
58	238.	428.	960.
59	227.	392.	893.
60	216.	359.	829.
61	207.	329.	770.
62	198.	301.	714.
63	189.	275.	662.
64	181.	252.	613.
65	174.	231.	587.
66	166.	212.	561.
67	159.	194.	537.
68	152.	177.	512.
69	145.	162.	489.
70	138.	149.	466.
71	131.	136.	443.
72	125.	125.	422.
73	119.	114.	401.
74	113.	105.	381.
75	107.	96.	382.
76	102.	88.	343.
77	96.	81.	326.
78	91.	74.	309.
79	86.	67.	292.
80	82.	62.	277.
81	77.	57.	262.
82	73.	52.	248.
83	69.	47.	234.
84	65.	43.	221.
85	62.	40.	209.
86	58.	37.	197.
87	55.	34.	186.
88	52.	31.	176.
89	49.	28.	166.
90	46.	26.	156.
91	44.	23.	147.
92	41.	21.	139.
93	39.	20.	131.
94	36.	18.	123.
95	34.	17.	116.
96	32.	15.	109.
97	30.	14.	103.
98	29.	13.	97.
99	27.	12.	91.
100	25.	11.	85.

SUM 207324.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6555.	5410.	2156.	2073.	207324.
INCHES		71.89	114.59	114.80	114.80
AC-FT		2684.	4278.	4286.	4286.

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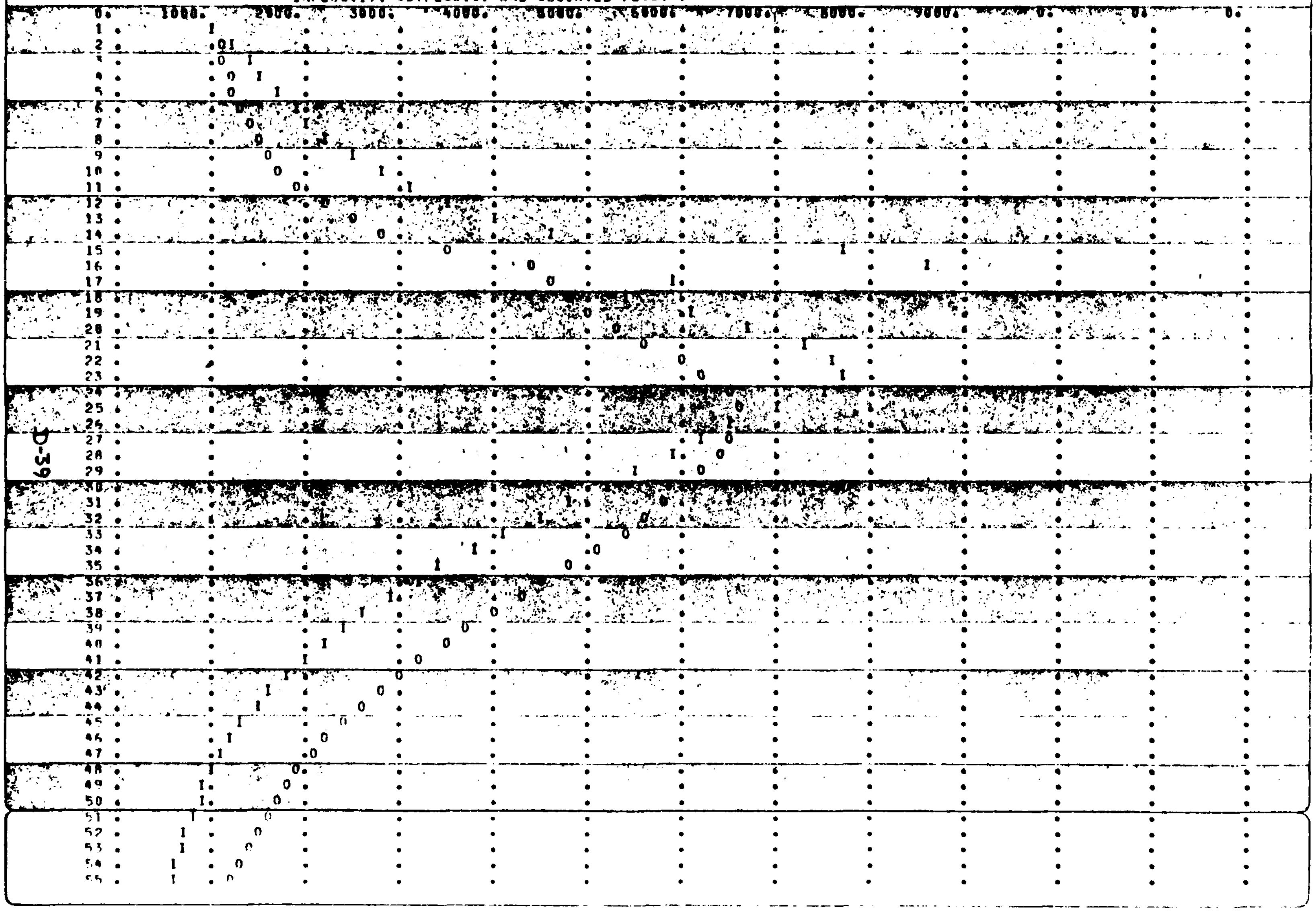
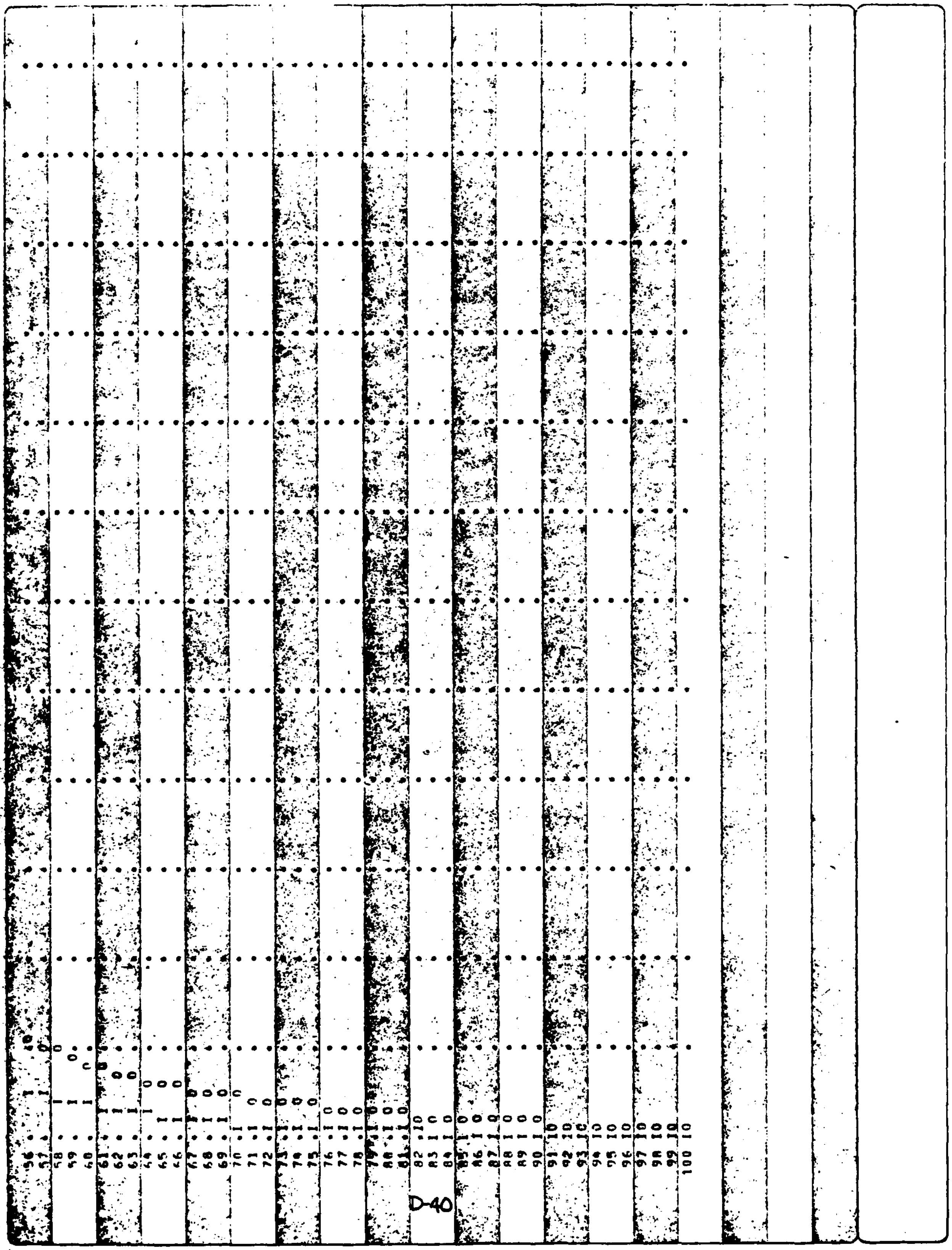
STATION 66 Lower Bolton

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)



D-39



RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	6	10539.	5816.	2045.	1964.	0.70
ROUTED TO	66	6555.	5410.	2156.	2073.	0.70

```
******************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
******************************
          BOLTON LAKE DAM INSPECTION
          BY D J MULLIGAN
          OCT 78

                    [illegible]SPECIFICATION
            NQ   NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
           150     0    15     0     0     0     0     0     0     0
                           JOPER     NWT
                               3       0

     **********   **********   **********   **********   **********

                    SUB-AREA RUNOFF COMPUTATION

          [illegible]
             ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT   INAME
                 6       0  [illegible] [illegible] [illegible] [illegible]  1

                          HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
   [illegible]

                          PRECIP DATA
                     NP   STORM     DAJ     DAK
                     24     0.0     0.0     0.0
                          PRECIP PATTERN
  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]   0.55   0.55   0.56   0.65   0.65
  0.68   0.81   0.94   1.13   3.56   1.62   0.65   0.65   0.65   0.65
  0.65   0.55   0.46   0.35

                          LOSS DATA
   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
   [illegible]

                   GIVEN UNIT GRAPH, NUHGQ=  19
   136.   502.  1071.  1329.  1297.  1084.   758.   549.   401.   289.
   204.   144.   105.    81.    55.    41.    29.    21.    16.
          UNIT GRAPH TOTALS   8062. CFS OR 1.02 INCHES OVER THE AREA

                          RECESSION DATA
            STRTQ=    0.0     QRCSN=    0.0     RTIOR= 1.00

                        END-OF-PERIOD FLOW
                   TIME   RAIN   EXCS   COMP Q
                      1   0.45   0.45     61.
                      2   0.45   0.45    287.
                      3   0.46   0.46    748.
                      4   0.46   0.46   1351.
                      5   0.55   0.55   1957.
                      6   0.55   0.55   2503.
                      7   0.55   0.55   2949.
                      8   0.56   0.56   3328.
                      9   0.65   0.65   3650.
```

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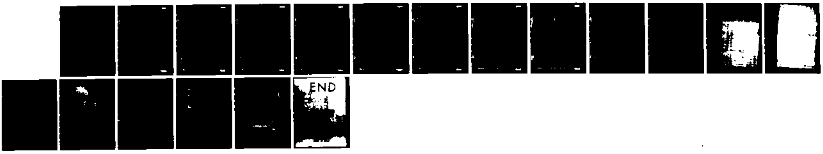
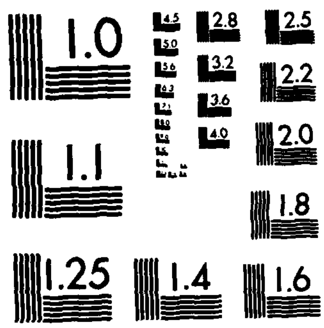
AD-A144 628 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS LOWER BOLTON LAKE DAM..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV SEP 78 2/2

UNCLASSIFIED F/G 13/13 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

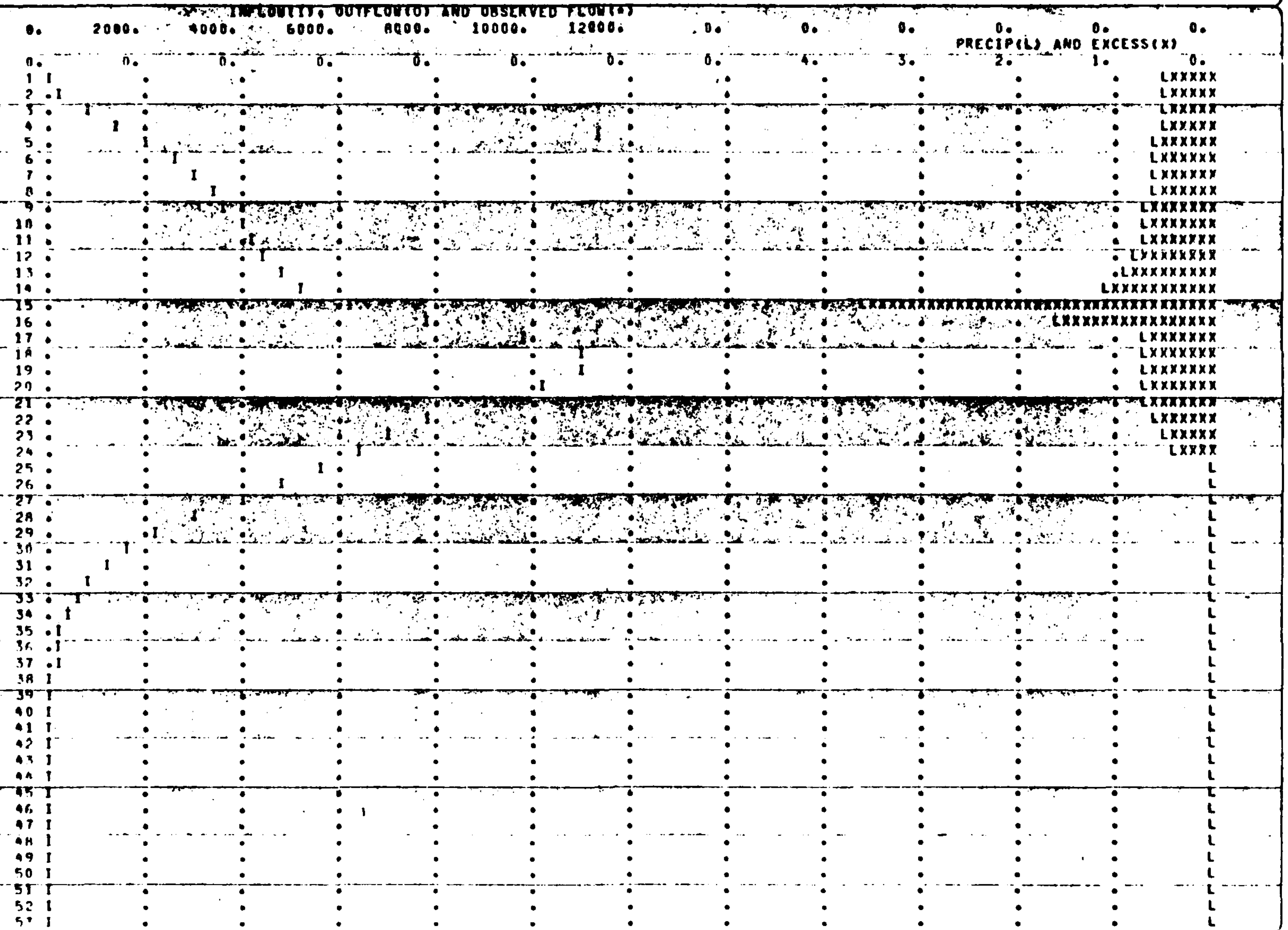
10	0.65	0.65	3939.
11	0.68	0.68	4212.
12	0.81	0.81	4494.
13	0.94	0.94	4821.
14	1.13	1.13	5294.
15	3.56	3.56	6142.
16	1.62	1.62	7751.
17	0.65	0.65	9773.
18	0.65	0.65	11083.
19	0.65	0.65	11086.
20	0.65	0.65	10809.
21	0.65	0.65	8983.
22	0.55	0.55	7856.
23	0.46	0.46	7077.
24	0.35	0.35	6385.
25	0.0	0.0	5659.
26	0.0	0.0	4836.
27	0.0	0.0	3918.
28	0.0	0.0	3008.
29	0.0	0.0	2201.
30	0.0	0.0	1574.
31	0.0	0.0	1127.
32	0.0	0.0	882.
33	0.0	0.0	567.
34	0.0	0.0	369.
35	0.0	0.0	249.
36	0.0	0.0	174.
37	0.0	0.0	119.
38	0.0	0.0	78.
39	0.0	0.0	50.
40	0.0	0.0	29.
41	0.0	0.0	15.
42	0.0	0.0	6.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.

132	0.0	0.0	0.
133	0.0	0.0	0.
134	0.0	0.0	0.
135	0.0	0.0	0.
136	0.0	0.0	0.
137	0.0	0.0	0.
138	0.0	0.0	0.
139	0.0	0.0	0.
140	0.0	0.0	0.
141	0.0	0.0	0.
142	0.0	0.0	0.
143	0.0	0.0	0.
144	0.0	0.0	0.
145	0.0	0.0	0.
146	0.0	0.0	0.
147	0.0	0.0	0.
148	0.0	0.0	0.
149	0.0	0.0	0.
150	0.0	0.0	0.
SUM	18.68	18.68	150598.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11086.	5876.	1569.	1004.	150597.
INCHES		17.81	19.01	19.01	19.01
AC-FT		2915.	3113.	3113.	3113.

OVF

STATION 6



D-45

OVN

HYDROGRAPH ROUTING

FLOOD ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
[illegible]	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	159.	363.	612.	906.	1245.	1629.	0.	0.	0.	0.
OUTFLOW=	445.	1314.	2475.	3850.	5549.	8567.	0.	0.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	[illegible]	[illegible]	[illegible]
2	161.	174.	495.
3	162.	518.	460.
4	174.	1049.	510.
5	197.	1654.	606.
6	229.	2230.	743.
7	[illegible]	[illegible]	[illegible]
8	312.	3139.	1098.
9	360.	3489.	1300.
10	409.	3794.	1528.
11	459.	4075.	1762.
12	510.	4353.	2000.
13	[illegible]	[illegible]	[illegible]
14	618.	5037.	2501.
15	681.	5698.	2796.
16	762.	6947.	3178.
17	872.	8762.	3693.
18	1005.	10428.	4345.
19	1137.	11084.	5009.
20	1248.	10647.	5572.
21	1324.	9556.	6170.
22	1366.	8379.	6502.
23	1385.	7467.	6647.
24	1386.	6731.	6659.
25	1374.	6022.	6564.
26	1349.	5248.	6366.
27	1311.	4376.	6067.
28	1261.	3462.	5676.
29	1201.	2605.	5330.
30	1134.	1888.	4991.
31	1062.	1350.	4633.
32	990.	965.	4271.
33	920.	685.	3918.
34	852.	468.	3596.
35	787.	309.	3293.
36	726.	211.	3009.
37	670.	146.	2745.
38	618.	99.	2501.
39	570.	64.	2277.

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40	525.	39.	2071.
41	485.	22.	1883.
42	448.	10.	1711.
43	414.	3.	1554.
44	384.	0.	1411.
45	356.	0.	1284.
46	331.	0.	1176.
47	307.	0.	1077.
48	286.	0.	986.
49	266.	0.	903.
50	249.	0.	827.
51	232.	0.	757.
52	217.	0.	693.
53	204.	0.	635.
54	191.	0.	581.
55	179.	0.	532.
56	169.	0.	487.
57	159.	0.	446.
58	150.	0.	409.
59	142.	0.	374.
60	135.	0.	343.
61	128.	0.	314.
62	122.	0.	[illegible]
63	116.	0.	263.
64	111.	0.	241.
65	106.	0.	221.
66	102.	0.	202.
67	98.	0.	185.
[illegible]	[illegible]	[illegible]	[illegible]
69	91.	0.	155.
70	88.	0.	142.
71	85.	0.	130.
72	82.	0.	119.
73	80.	0.	109.
74	78.	0.	[illegible]
75	76.	0.	91.
76	74.	0.	84.
77	73.	0.	77.
78	71.	0.	70.
79	70.	0.	64.
80	68.	0.	59.
81	67.	0.	54.
82	66.	0.	49.
83	65.	0.	45.
84	64.	0.	41.
85	63.	0.	38.
86	63.	0.	35.
87	62.	0.	32.
88	61.	0.	29.
89	61.	0.	27.
90	60.	0.	24.
91	60.	0.	22.
92	59.	0.	20.
93	59.	0.	19.
94	59.	0.	17.
95	58.	0.	16.
96	58.	0.	14.
97	58.	0.	13.
98	57.	0.	12.
99	57.	0.	11.
100	57.	0.	10.

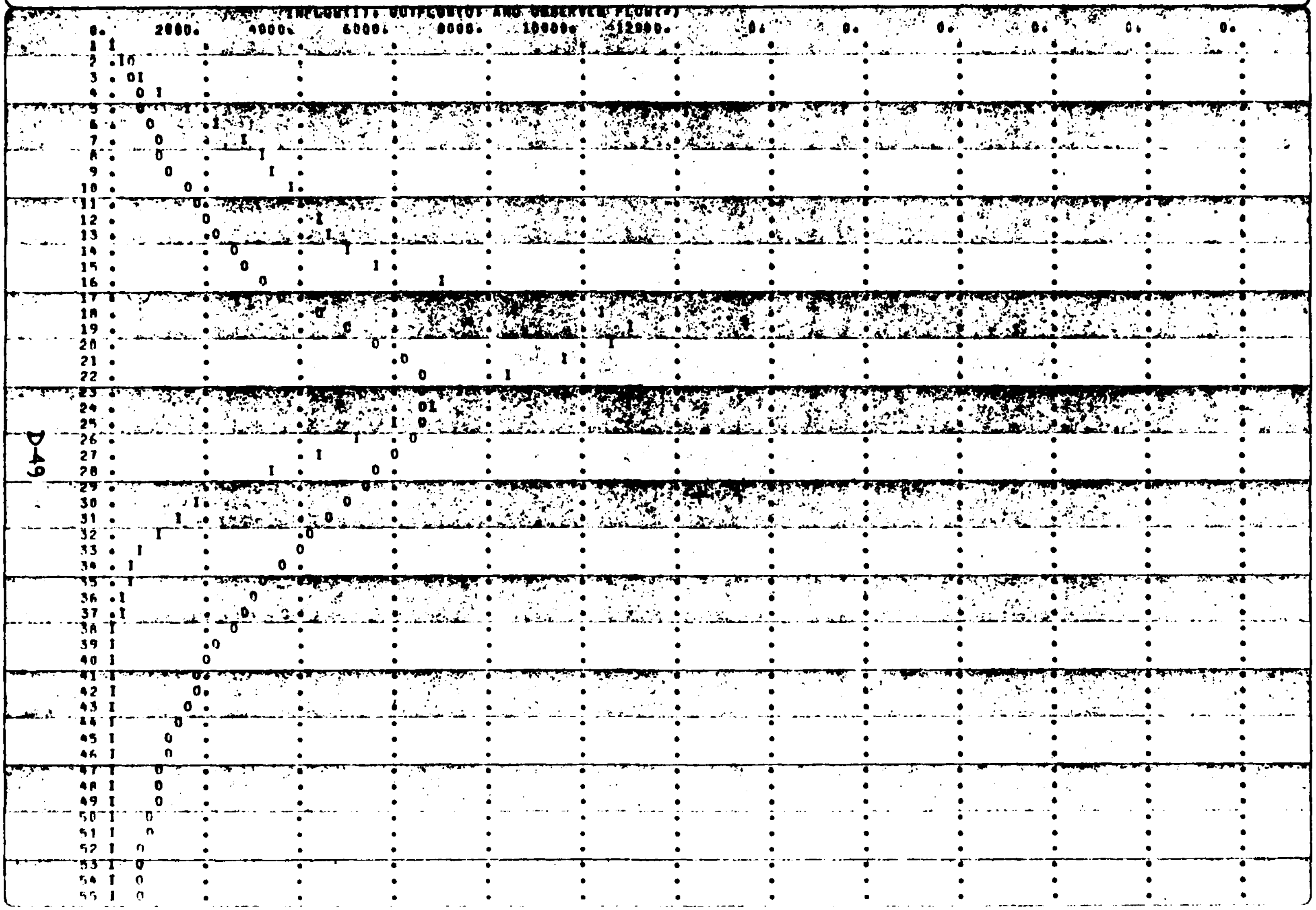
101	57.	0.	9.
102	57.	0.	8.
103	56.	0.	8.
104	56.	0.	7.
105	56.	0.	7.
106	56.	0.	6.
107	56.	0.	5.
108	56.	0.	5.
109	56.	0.	5.
110	56.	0.	4.
111	55.	0.	4.
112	55.	0.	4.
113	55.	0.	3.
114	55.	0.	3.
115	55.	0.	3.
116	55.	0.	2.
117	55.	0.	2.
118	55.	0.	2.
119	55.	0.	2.
120	55.	0.	2.
121	55.	0.	2.
122	55.	0.	1.
123	55.	0.	1.
124	55.	0.	1.
125	55.	0.	1.
126	55.	0.	1.
127	55.	0.	1.
128	55.	0.	1.
129	55.	0.	1.
130	55.	0.	1.
131	55.	0.	1.
132	55.	0.	1.
133	55.	0.	1.
134	55.	0.	1.
135	55.	0.	0.
136	55.	0.	0.
137	55.	0.	0.
138	55.	0.	0.
139	55.	0.	0.
140	55.	0.	0.
141	55.	0.	0.
142	55.	0.	0.
143	55.	0.	0.
144	55.	0.	0.
145	55.	0.	0.
146	55.	0.	0.
147	55.	0.	0.
148	55.	0.	0.
149	55.	0.	0.
150	55.	0.	0.

SUM 155840.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6659.	4730.	1622.	1039.	155840.
INCHES		14.33	19.66	19.68	19.68
AC-FT		2347.	3218.	3221.	3222.

DVF

STATION 66



RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	6	11888.	5876.	3569.	1084.	3.07
ROUTED TO	66	6659.	4730.	1622.	1039.	3.07

APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
CT	509	NED	CT	013	01				LOWER BOLTON LAKE DAM	4148.0	7225.6	30NOV78

POPULAR NAME	NAME OF IMPOUNDMENT
	BOLTON LAKE

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	07	BOLTON POND BROOK	QUARRYVILLE	0	500

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
RECTPG	1940	R	19	19	2325	1250	NED	N	N	N	N	30NOV78

REMARKS

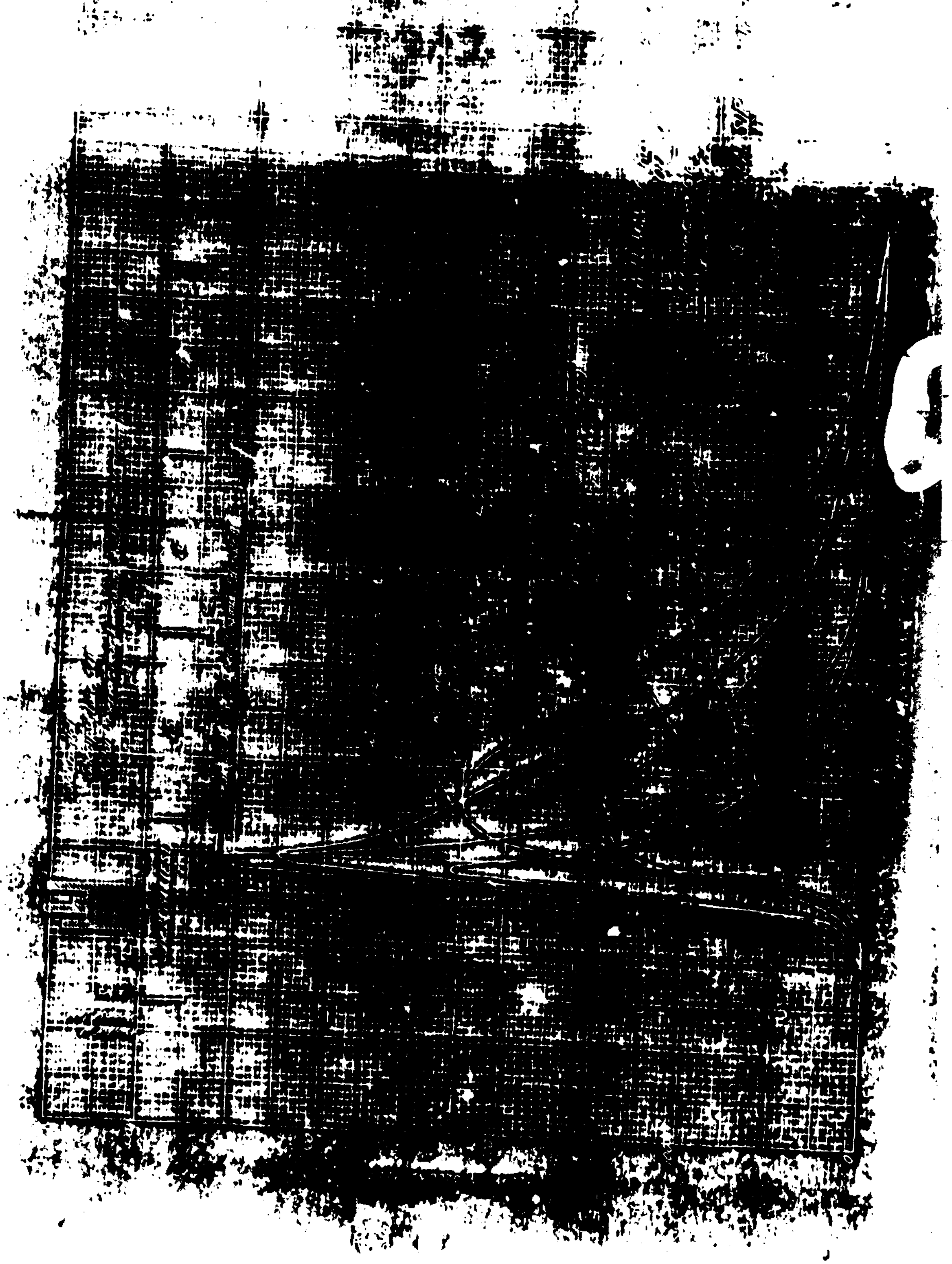
D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
2	1080	U	200	8400												

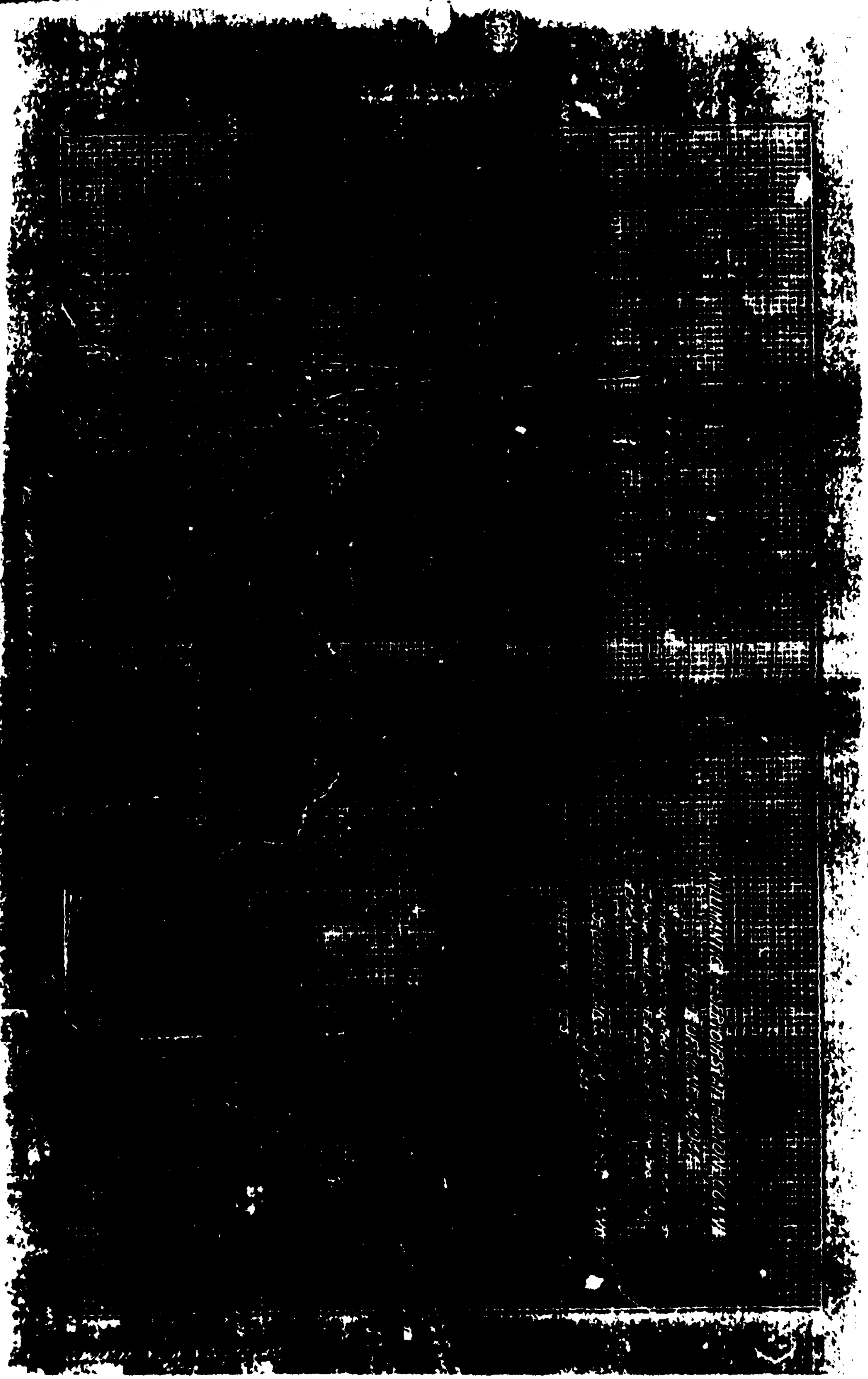
OWNER	ENGINEERING BY	CONSTRUCTION BY
STATE OF CT, DEP	STATE PUBLIC WORKS DEPT	FEDERAL WPA PROJECT

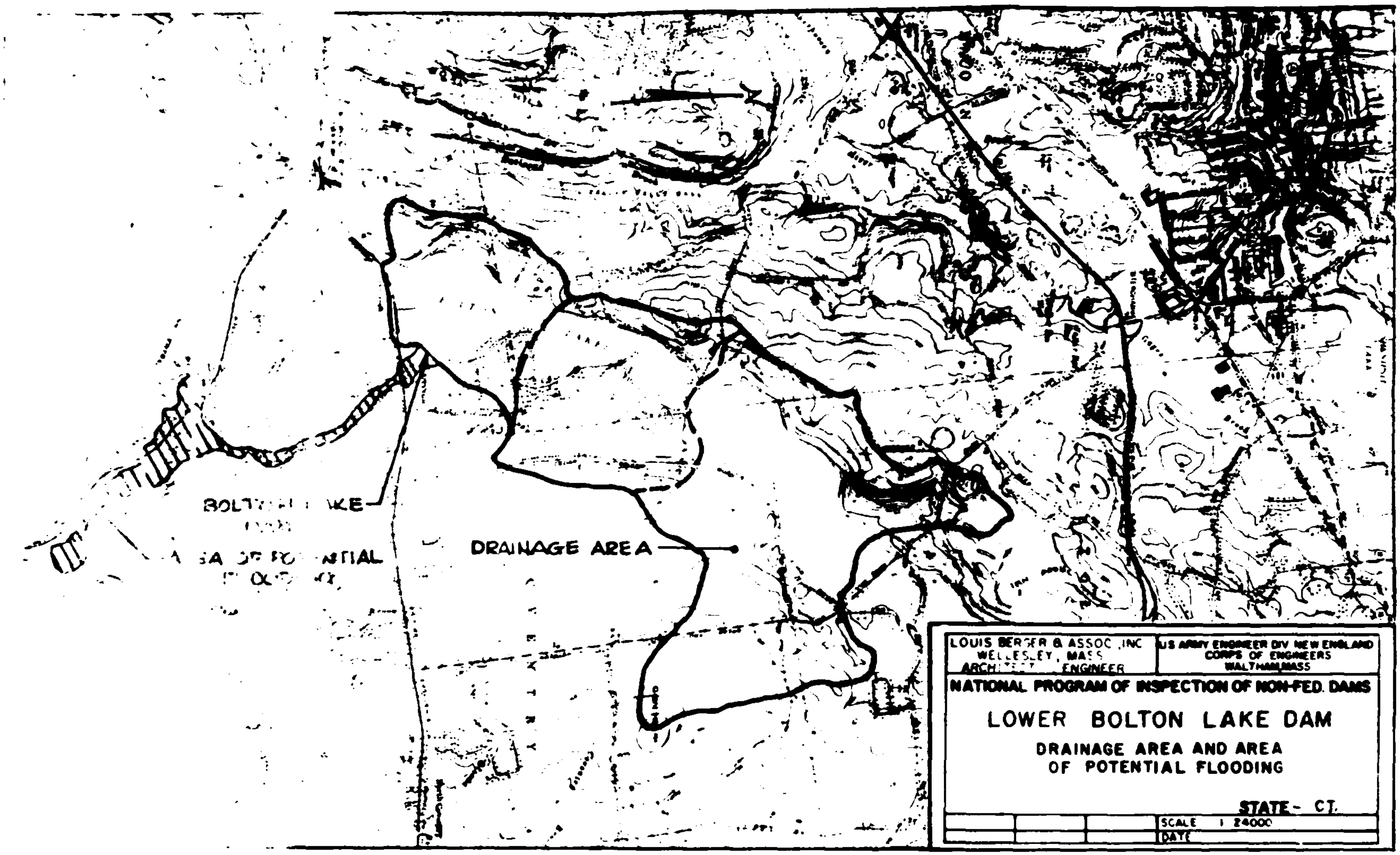
REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
LOUIS BERGER + ASSOCIATES, INC.	25SEP78	PL92-367

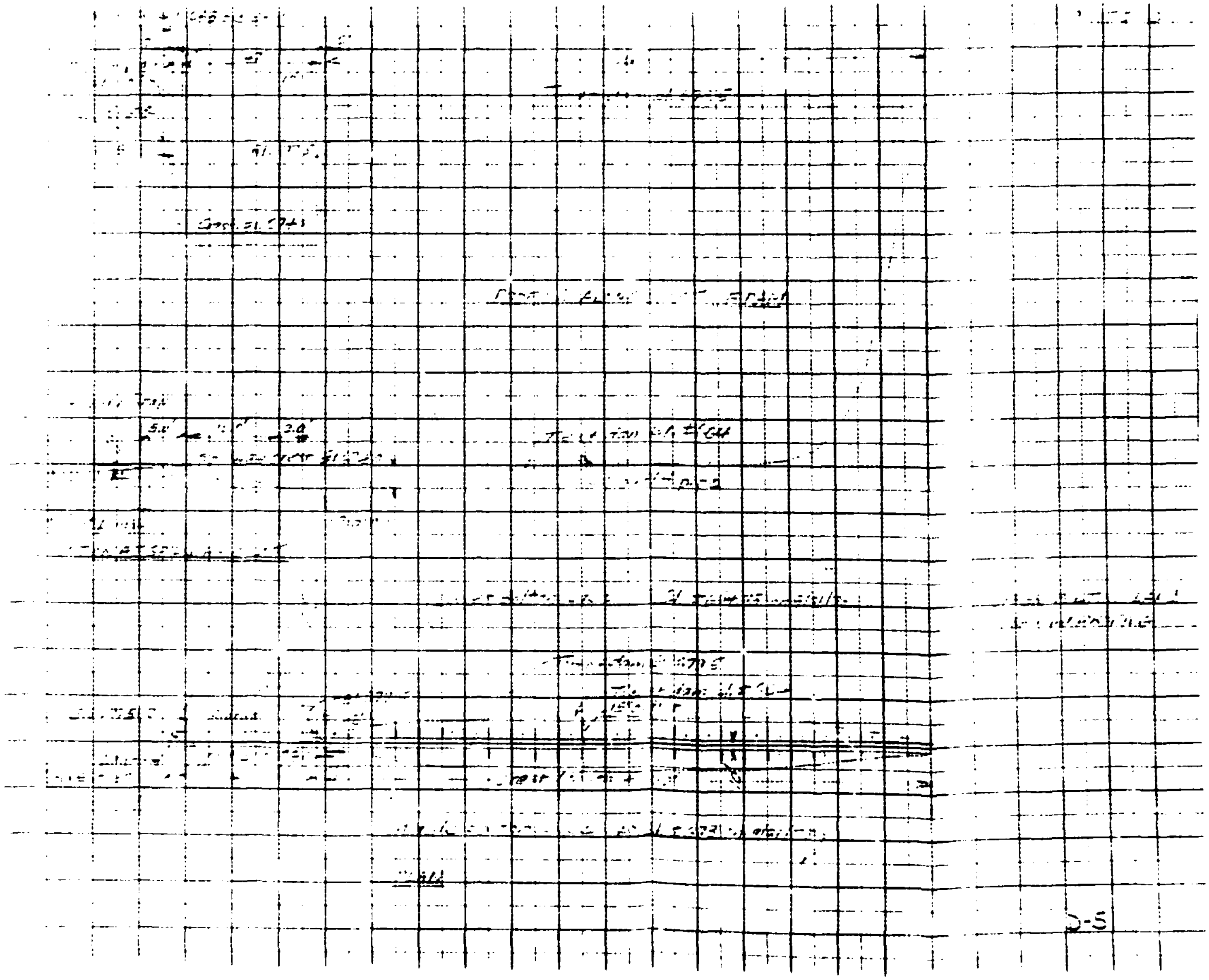
REMARKS



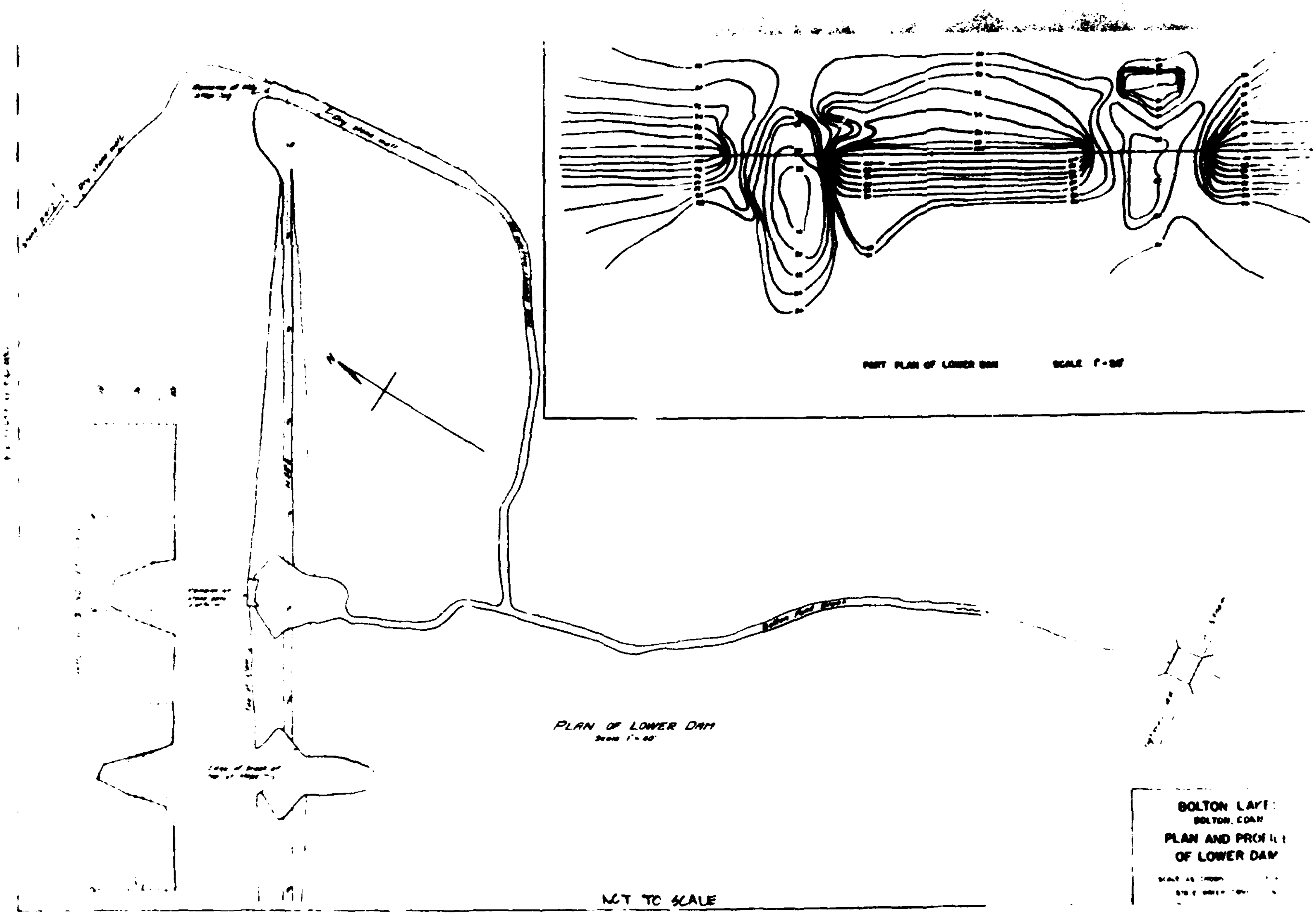




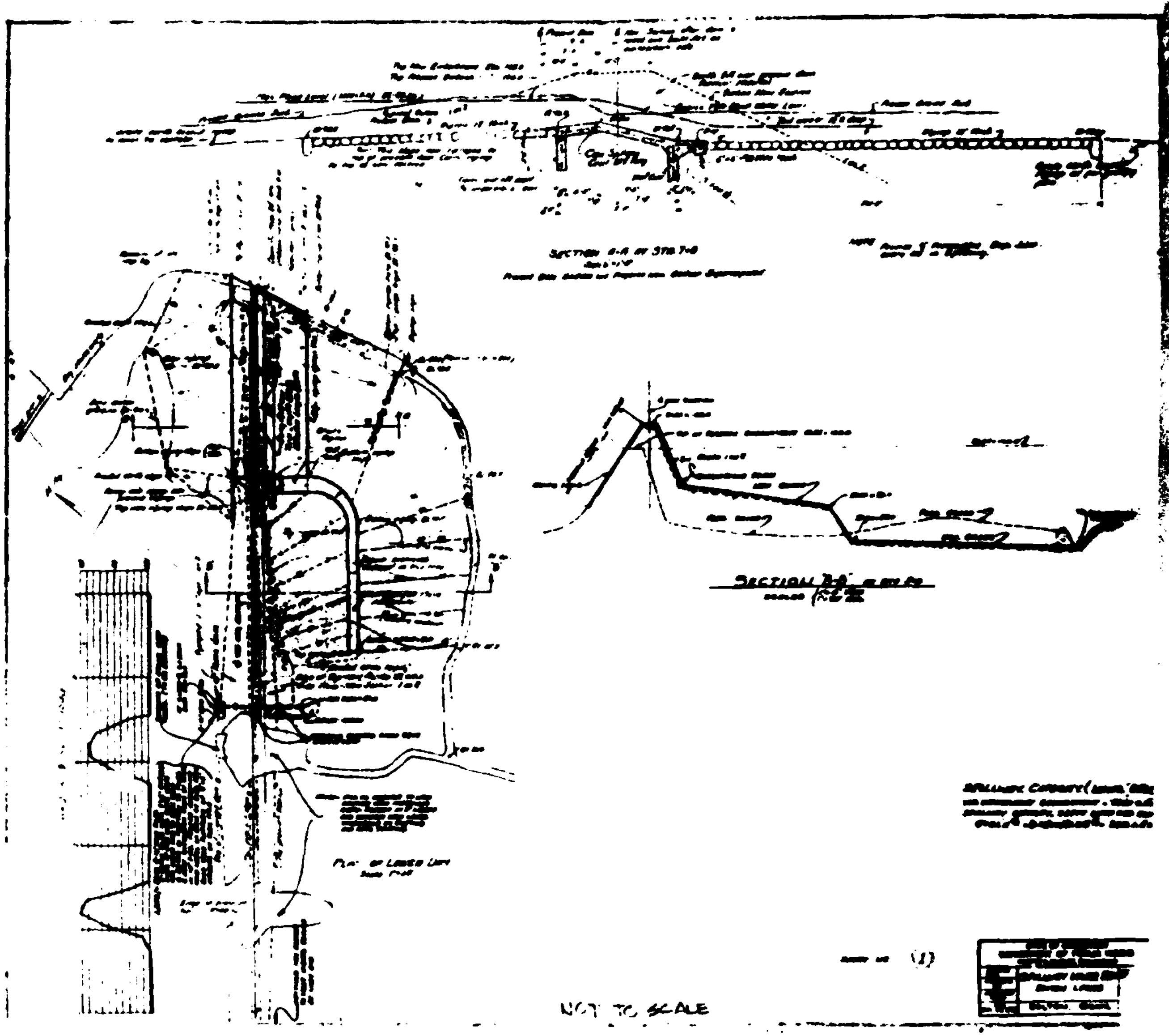
DRAINAGE AREA
LOUIS BERGER & ASSOC. INC
WELLESLEY, MASS
ENGINEER
US ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
LOWER BOLTON LAKE DAM
DRAINAGE AREA AND AREA
OF POTENTIAL FLOODING
STATE - CT.
SCALE 1 24000
DATE



D-5



PART PLAN OF LOWER DAM
SCALE 1"=30'
PLAN OF LOWER DAM
Scale 1"=40'
NOT TO SCALE
BOLTON LAKE
BOLTON, CONN
PLAN AND PROFILE
OF LOWER DAM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END

FILMED

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